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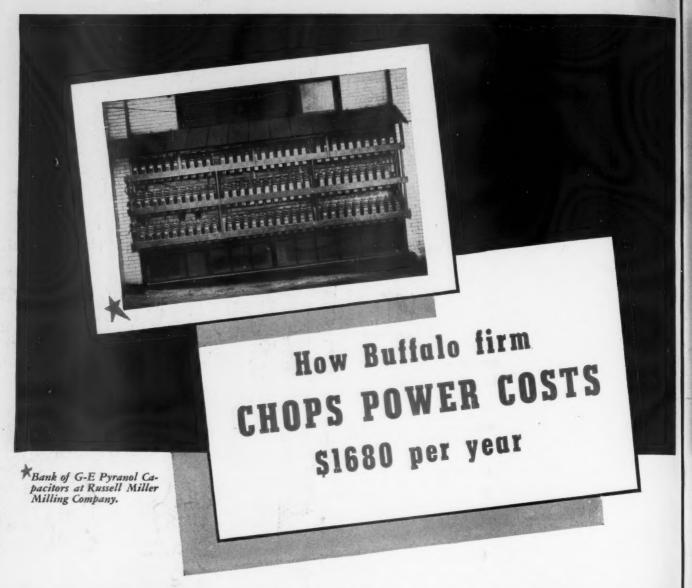
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MAY · 1947

Don't Miss

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Office Building Maintenance . . . page 64
NISA Convenes in Detroit . . . page 67
Utilities Back Planned Lighting . . page 71
Industrial Lighting Techniques . . page 74

In This Issue



The Russell Miller Milling Company of Buffalo uses 1800 to 1900 electrical horsepower in handling flour, feed, and grain products. Induction motors supply most of the power and considerable reactive kva is drawn with a resulting plant power-factor of about 65 per cent.

Since the power company was required to supply this load having excessive KVAR content, there was a charge for the kilovars (reactive kva) as well as for the kilowatts—a penalty that cost the Russell Miller Milling Company approximately \$1680 per year.

A bank of General Electric capacitors was installed. Here the Russell Miller Milling Company now produces kilovars on the spot, so to speak—with no fuel cost, no attendance, no maintenance. Power factor has been raised to better than 95 per cent. \$1680 a year is saved.

Capacitors May Make Similar Savings For You

If you have a penalty clause in your power contract—power factor, kva or kilovar—capacitors can save you money. If you have circuits that are overloaded, or if you want to add to fully loaded circuits, capacitors often provide the answer—30% improvement is not unusual. Or if you are having troubles because of low voltage due to poor power factor, capacitors may be the answer.

In any of these cases, a General

Electric sales engineer will be glad to work with you in determining whether capacitors can help you, and just how much they will save. Just call your G-E representative, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.



GENERAL



ELECTRIC

Electrical Construction and Maintenance With which is consolidated Electrical Contracting. The Electragist and Electrical Record...Established 1901

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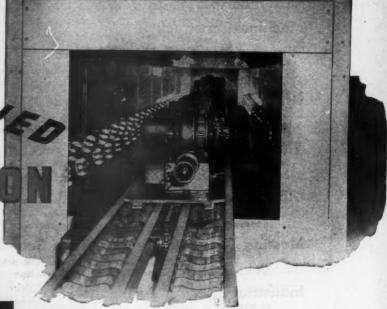
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A HANDKERCHIEF!





TRUMBULL TELECTRIC

The facts on this installation of a Trumbull Raymersion Infra-Red Oven should be important to many manufacturers for the following reasons:

- 1. The oven, 45 ft. in length, was assembled from unit sections which permit building to any width, height or length.
- 2. A completely assembled oil burner is sprayed with a force-dry gray paint . . *passes through the oven at 2 ft. per minute . . . maximum temperature 170° F. . . . operating load 90 KW.
- 3. Production is 320 units per day . . . saving the plant thousands of dollars annually over the former process.
- 4. The finish is so dry and so clean that it may be wiped with a white handkerchief without spotting. If your present baking or drying process is not satisfactory, ask the nearest Trumbull representative for recommendations. Raymersion Ovens will save time and space, improve finish, reduce costs. Bulletin on request.

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WORLD LEADERSHIP...

Our Duty and Our Opportunity

APITALISM in Europe and the rest of the world is challenged by a real and formidable rival, communism, For capitalism to thrive a reasonable amount of prosperity is essential. Communism uses poverty to advance itself.

Except for the Western Hemisphere, most of the world came out of the war poor. Two years after V-E Day it is still poor. It needs dollars. It needs credit. It needs capital. It needs trade. It needs technical and managerial skills.

If we in America are to help the rest of the world back to its feet, starting it again on the road to peace and a free economy, we should try to supply those needs within the limits of our capacity.

We must not overtax our own strength. For the first requirement of a stable world is a strong United States. But we must accept leadership in international economic recovery—in our own self-interest.

What can the United States do to help men back to prosperity in a world economy which will allow them freedom and incentive? There are many things. But here are two of the most important:

- 1. The United States, through Congress, must determine the pattern and the total of the foreign loans or grants it can afford. We must answer three questions. How much will the new program cost? Can we afford it? Have we the technicians and managers to watch the loans, assuring their fruitful use?
- We must demonstrate that we do not intend to raise our tariff walls to prohibitive heights when our debtors begin to repay us in goods and services, which is the only practical way they can pay us. Otherwise our loans will become losses.

If the United States is to meet even the minimum requirements of world rehabilitation, Congress eventually must authorize more advances than those to Greece and Turkey. The \$400 million for those two countries will not do the over-all job of political and economic defense which we have begun. A min-

imum of \$5 billion, if promptly and wisely applied in eight to ten countries, might suffice. BUT this \$5 billion will be on top of approximately \$16.8 billion which we have spent or earmarked during the past two years for use abroad, including our full share of the World Bank and Fund. We shall do a faster and more effective job if Congress will thus add up the foreseeable total of our international aid, and, even though the total looks imposingly large, commit us to it, with proper collateral safeguards from the debtor nations.

Congress need not try to foretell all contingencies, like last winter's weather in Britain, and it certainly should not create the impression that nations need only ask for billions to receive them. On the other hand, the war should have taught us the miserable consequences of "too little and too late." The President should have learned that he engenders skepticism by going to Congress with parts of a program, as he has done in the British, Grecian and Turkish loans. Within the limits of our capacity, we must make the decision now to see the whole job through—or throw in the sponge.

In the interest of the debtor nations—as well as in our own interest—the loan program should be hard-boiled. Rehabilitation loans must really rehabilitate. They must produce a state of economic health which will permit the World Bank and private capital to take over the task of financing world recovery—as perhaps can be done today in France and the Low Countries.

The loans, therefore, must be within the limits of our technical and managerial ability to implement them. Without technical help, Greece can not use its loan effectively—to rebuild railroads, clear ports, revive agriculture. Without skilled supervisors, Germany can not be made to pay its way. Money alone won't pull China from the brink of economic chaos.

Our lending calls for more than money. It calls for trained personnel to help the recipients utilize the loans effectively—geologists, construction and sanitary engineers, monetary experts, and management and agricultural specialists.

Loans are necessary but they are only a first step. A long-range program requires the opening of the half-closed doors of world trade-our own door, too.

We will have to get used to the idea that, when our debtors pay us, they must pay us largely in goods and services. Refusal to permit such repayments in the twenties helped start the world de-

pression in the thirtiesand the loss of our investments. Imports do tend to raise living standards, and a two-way trade program need not require us to slash our present tariff

The complexion of our foreign trade has changed since the war. Our manufacturing capacity has increased and our rawmaterial self-sufficiency is tending to decline. For example, we probably shall have to continue importing copper and zinc and to increase our prewar dependence on imported lead. We may soon have to depend heavily on imported oil, and-gradually -on a growing volume of iron ore from abroad. Our normal dependence on imports for commodities like rubber, tin and silk will continue.

Our population has gone up 10 million in the last

decade, and we now have a \$176 billion national income, making room for more imports.

As a result of every nation's recent attempts to make itself secure and self-sufficient by slamming its trade door, a world-wide series of quotas and restrictions is blocking international trade. Even more, government buying and selling threaten to take commerce out of the hands of private traders, placing it in the uninspired care of bureaucratic negotiators.

Our government has taken the lead in calling the conference of 18 nations, now meeting at Geneva, to open as many trade doors as possible. The American delegates will bargain product by product and country by country - all summer, if necessary - for

lower tariffs, fewer quotas and a free flow of private trade. The task is a long one, and the results are as vet uncertain, but, if success is achieved, an immense opportunity for good works and good earnings will lie before American businessmen.

This is no picavunish opportunity. Authoritative estimates put our 1947 exports at \$11 billion and our imports at \$6 billion. That's substantial. It is

> greater than the value of all crops grown on our farms (\$101/2 billion) and exceeds the value of all shipments of industries such as automobiles (\$9 billion), textiles (\$8 bilbillion).

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vital, not to be shrugged off, not to be kicked around as a football of party politics. Republicans and Democrats agree on a non-partisan foreign political policy. They should agree also on a non-partisan foreign economic policy. The foreign relations of the United States, political or economic, can no longer be log-rolled hither and yon.

A general program for international recovery, outlined here, will bring its full quota of aches and pains. But lack of a program will produce economic and political troub-

les on a vast scale; timid retreat will invite economic disaster and war.

By an intelligent, bold and resourceful program, we have a chance to win through to a long peace in the kind of world we want. Unless America provides the leadership, there can be no such program. Then Communism merely needs to hang around long enough to pick up the pieces.

lion) and chemicals (\$8 International trade is

Ours is the responsibility and the opportunity.

Mus H. W. haw. N. President McGraw-Hill Publishing Company, Inc.

THIS IS THE 58TH OF A SERIES

A NEW ENTERPRISE

pany, in the accompanying editorial, of an effective

world economic policy is not a mere verbal exercise. In the faith that we as a nation shall develop such a

policy, this Company, following a trail blazed by

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General contractors believe that the peak in construction has been reached. A study by the F. W. Dodge Corporation tells us that 53 percent of the group polled believed that the peak was already here, while a minority group anticipated further increases up to 10 percent above current levels. Improvements, which may contribute to somewhat lower building costs, or at least a leveling off, will come in the unusual factors which have had a lot to do with the present high costs. These include labor inefficiency caused by irregular flow of materials, delays due to inadequate supply of skilled workers and excessive non-productive labor in obtaining and handling critical material items.

NISA

The National Industrial Service Association convention in Detroit which is reported in this issue set a new record in attendance and in the opinion of many who were there, a new record in interest in the proceedings. NISA convention policy of devoting a good share of their convention programs to practical shop operation discussions and experience reports, develops a wealth of material of direct and immediate interest to the motor shop operators. It contributes to close attendance in every session by the delegates and a thoroughly constructive meeting.

Rewind Time

From the many papers presented at the National Industrial Service Association convention in Detroit, it would be difficult to select any particular one or two that were greatly superior. We are presenting a typical one by Mr. S. U. Steffner of the Chattanooga Armature Works on "Meeting Polyphase Rewind Time Sched-

ules", not only as an excellent and thoroughly informative article on the subject, but characteristic of the type of work which is becoming more and more prevalent in the motor shop industry. You will find this article on page 72.

Planned Lighting

One of the outstanding events of the recent commercial sales conference of the Edison Electrical Institute in Chicago was the anouncement of a "Planned Lighting Program". Developed to help utilities promote modern lighting in their own communities, it is the first nation-wide campaign of its kind since the introduction of fluoresecent lighting. Its success depends squarely upon the wholeheated cooperation of all branchés of the industry, and its potentialities are tremendous. Is your local utility prepared to tie in with this all-industry activity? Are you prepared to give it your support? Read "Utilities Back Planned Lighting" on page 71.

Landing Lights

A request from the County Engineer to eliminate lighting on a bridge near Cleveland airport because it is inclined to be confused with the port's runways, is a step backward for the lighting industry. Unquestionably, we are going to have more highway and bridge lighting in the coming years, rather than less. The accidents which happen on our highways due to inadequate lighting are a far more serious problem than airport hazards. If there is confusion between brightly lighted highway areas or bridges and airport runways, it seems a simple enough problem to give the airports unique and distinctive lighting equipment to eliminate it. This is far more sensible than cutting off vitally essential lighting in the area.

Maintenance

The growing complexity of office building wiring systems, the greatly increased lighting levels and the use of electrical office machinery in recent years has caused a concurrent development of planned maintenance schemes for such buildings. How electrical maintenance is made easy through planning and time-saving tools is the subject of George P. Forde's article on "Office Building Maintenance" on page 64. Many of the problems encountered are typical ones which you will find applicable to your own office building jobs.

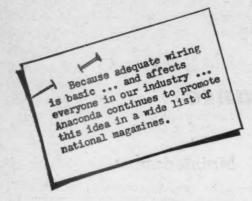
Mercury Vapor

One of the most useful and least generally understood light sources used in industry is the high intensity mercury vapor lamp. Such lamps have very high lumen output per watt and because they are concentrated sources, are ideally suited for providing relatively high intensity levels in high bay areas. Berlon C. Cooper's industrial lighting techniques article this month on page 74 discusses the application of the mercury vapor lamp to industrial lighting problems.

Research

Buildings constructed for industrial research operations are often good examples of new and unsual wiring methods. Because of the experimental nature of the project, there is a need for unusual flexibility and accessibility in the electrical system. The Research Center of the Johns-Manville Corporation now being developed near Bound Brook, New Jersey, is not only a great construction project, but involves many very interesting wiring methods. Industrial Editor Hugh Scott brings us the story entitled, "Wiring and Research Center" on page 61.

They just can't carry this load too long!



INADEQUATE WIRING, the industrial jinx, is too heavy a burden for any factory power lines. For, overtaxed, overextended, obsolete wiring can cut operating efficiency 25 to 50 percent.

And, sooner or later, this sinister acrobat causes tie-ups that result in costly shut-downs for extensive alterations.*

Call in your plant power engineer, consulting engineer, electrical contractor or utility power salesman. These are the men who can throw a net over him!



ANACONDA WIRE AND CABLE COMPANY

PENNY-WISE AND POWER"

MACHINE CONSTRUCTION

9

CONSTRUCTION COSTS are at or near their peak. Some labor rate increases are still in prospect and similar increases in the manufacturing industries may force some lines of material upward. However, improved materials supply, better labor efficiency and increased competition as prices tend to stabilize will help to hold construction costs in line.

IF BUILDING CONSTRUCTION COSTS are stabilized at current levels or even a little below they will still provide our economy with a serious problem. To the average man the building of a home is a major financial undertaking. To many corporations and institutions, buildings represent a major investment of capital. A substantial increase in the price of a can of beans is viewed with alarm. A similar increase in construction costs becomes a national calamity. Yet both are segments of the same national economy.

ANY SINCERE APPRAISAL of the building industry will uncover many practices which, if corrected, would aid in reducing costs and giving the public more value for his dollar. But, in the long run, the appraiser is going to run up against the rather obvious fact that building construction is still pretty much a handicraft industry. Buildings are assembled on the site from partially processed materials by skilled tradesmen using comparatively few specialized tools and practically no power. In a machine tool economy handicraft and muscle power are luxuries.

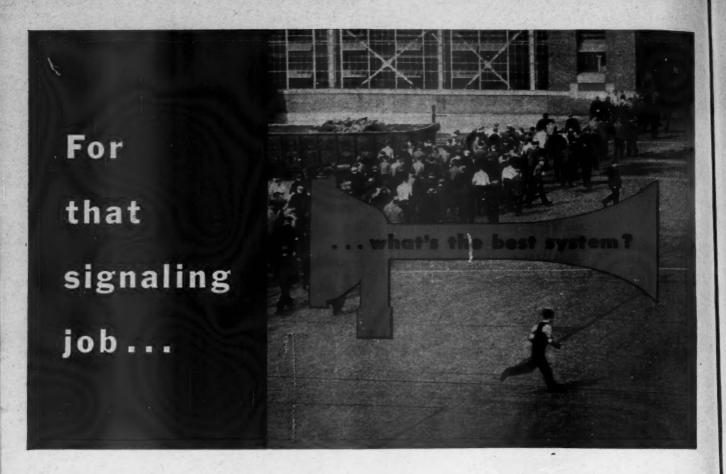
PREFABRICATION OFFERS the benefit of factory assembly, machine tools and repetitive operations, but the cost of handling and shipping large and heavy finished products, the relatively high overhead of factory operation and its limited scope (at least as we know it today) eats up possible major economies from this direction. Certainly prefab sections, utility centers and the like are here to stay and may open the way to better values but it will be a long time before they represent more than a tiny fraction of the total building job.

THE MOST CHALLENGING OPPORTUNITY, however, is still relatively unexplored. Instead of taking the building job to the factory, we can bring the factory to the building site. Electric power is highly portable. The production machinery for building construction can certainly be adapted to the special surroundings and conditions under which it must operate. The genius of the builders can certainly develop techniques and methods for efficient operations. An amazing array of already available portable power tools are still waiting to be applied to building.

WILL UNIONS COOPERATE? They may yet be in the forefront of such a development. The current apprenticeship rate is barely enough to replace death and retirement. The industry is headed for new high levels of construction. There is far greater danger that men may walk the streets from an industry priced out of its market by clinging to handicraft methods than there is from any technological revolution.

THE ELECTRICAL CONSTRUCTION INDUSTRY should take the leadership in fostering mechanized construction. The electrical contractor as well as the other mechanicals are badly squeezed under present construction cost levels. If building costs can be reduced we have a wider range for selling the superior services of electrification that the public wants. And one way is the development and use of power tools in our own operations.

Wm. 9. Stuart



GraybaR can help meet any communication need

Whether your customer wants a trumpet blast, a clang, buzz, howl, or whir-r-r- Graybar distributes the signal device that will produce it at the level required to penetrate any noise in his plant.

A Graybar Signaling Specialist can help you plan the best signaling or communication system for any requirements. We distribute industrial horns, sirens, howlers, buzzers, electric bells; annunciators; fire-alarm systems; public-address systems; Webster Teletalk intercommunication systems; Edwards Lokator code-paging or calling systems and interior telephone systems; and accessories for all signaling systems.

Our near-by office can simplify your job of getting everything electrical. It's still impossible for us to maintain complete stocks today — but, if you plan ahead with us now, chances are the items you want will be available when you need them. Graybar Electric Company. Executive offices: Graybar Building, New York 17, N. Y.



Who's a Graybar Specialist?



Every Graybar Representative, of course, is an electrical specialist - with the intelligence, knowledge, and experience to make sound recommendations on everyday electrical applications. But even a superman couldn't be an expert on all the items we handle! That's why, at each of our 18 key houses, there are Graybar Specialists in *lighting*, power apparatus, signaling and com-munication, inside and outside electrical construction. These men have intensive experience in their respective fields and are competent to handle complex technical problems. The services of both your Graybar Representative and near-by Special-ists are always available to you.

4751

IN OVER 90 PRINCIPAL CITIES

WIRING . LAMPS and LIGHTING . COMMUNICATION . SIGNALING . VENTILATION . CONTROL . POWER APPARATUS . TOOLS

Factory area is illuminated to 30 footcandles intensity by 1000-watt incandescent high-bay units (A). Lighting transformers (37.5 kva. 440/120/240 v.) are mounted on steel columns (B) and are fed from 1000-amp. plug-in busduct (C).

WIRING a Research Center



Progressive electrical engineering and modern installation techniques are behind the distribution system of the new Johns-Manville laboratory development.

MODERN application of Science to Industry is the dominant objective of the new 93-acre Johns-Manville Research Center now being developed near Bound Brook, New Jersey. The completed project, providing extensive facilities for research and engineering, experimental factory development, machine shop operations, water filtration, waste processing, administration, storage and garage re-

By Hugh P. Scott

quirements, will utilize 337,000 square feet of floor space in the six-building plant.

New construction methods, new installation techniques and new conceptions of electrical service for the laboratory field are found at the Bound Brook project. An underground celular power distribution system, utilizing over 8,000 feet of transite duct, carries primary current at 4160 volts to local transformation areas in each individual building. In the building already completed, the connected electrical load includes over 2,000 motor horsepower and 430 kw. of lighting.

Distribution panels are dead front, are equipped with automatic branch circuit breakers and are of sufficient size to allow at least 4-inches of gutter space on all four sides of panel board. All wiring is installed in rigid steel conduit.

Movable laboratory partitions, with pre-installed electrical wall receptacles (also outlets for gas, water and air) can be moved at will to conform to space requirements. Over one and a half miles of fluorescent lamps light the laboratory area with 40-footcandle intensities. An air conditioning system of 67,000 cfm. capacity serves laboratory and testing areas. A combination paging and transcription loud speaker installation serves all areas. The development is large, modern, and electrical.

Functional architecture combines beauty with simplicity in the buildings which will surround a landscaped quadrangle. Laboratory windows afford a view of this central park area while factory exits open on surrounding loading platforms, railroad sidings and parking areas. Building construction is of steel frame with salmon-colored brick exteriors and large glass areas facing the park, asbestos-cement sheeting being used for exterior walls adjacent to utility areas.

The first building to be completed contains a product development laboratory and ten experimental factories. It is devoted to wet semi-works, that is, to small scale construction and pilot plant testing of wet or soupy processes. Covering an area 572 by 135 feet, the structure is divided longitudinally into two areas by a glass-enclosed promenade which extends the full length of the building and separates the laboratories from

the experimental factories. The laboratory section, two stories in height, is divided into individual working areas by movable partitions. These partitions consist of asbestos-cement panels that are "buttoned" on to vertical steel studs on 2-foot centers. Conduit, concealed in each partition, carries the necessary wiring, gas, water and air for each laboratory. Utility services, installed beneath the asphaltic tile and concrete flooring, have junction boxes and taps at 11-foot intervals. By locating partitions over the taps, connecting sub-floor utilities to partition-encased conduit, laboratory widths can be varied by multiples of 11 feet in accordance with operational requirements. Partition panels can be quickly removed from studs to facilitate access to utilities. In the factory areas, adjustment of space is also

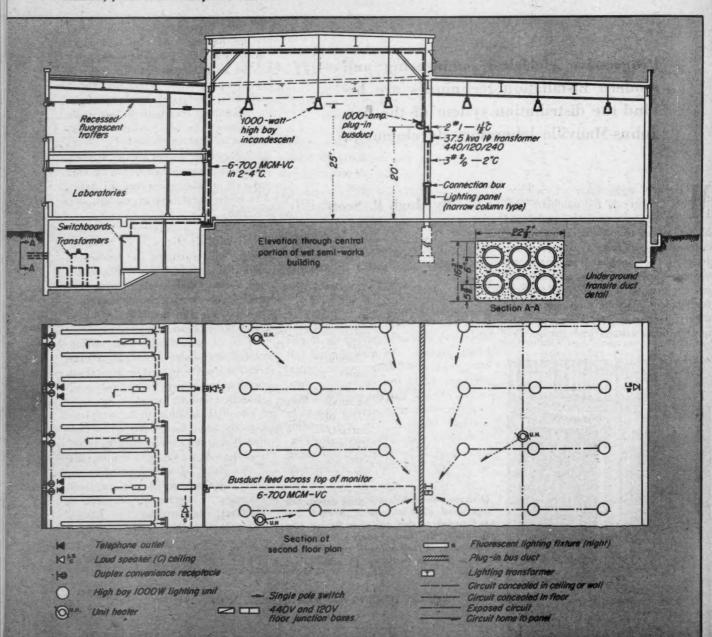
possible. Rear walls are constructed with removable asbestos-cement sheets to permit either the addition of temporary housing for extra-length equipment or permanent future expansion.

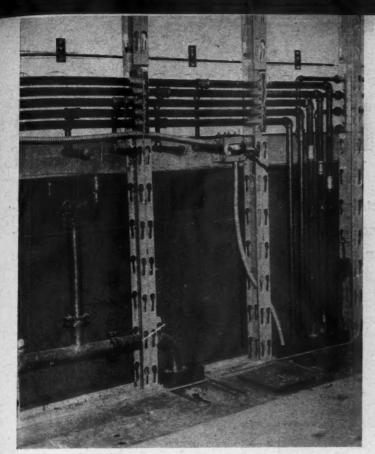
Utility service at 4160 volts 3 phase is carried to the Research Center's primary outdoor switching station through aerial feeders. Of the three feeders originating at this outdoor switching station, one serves two manufacturing buildings previously erected as part of a separate, adjacent J-M plant. A second main feeder (aerial) carries primary current to the filter plant and pumping station located 2500 feet southeast of the switching station, on the north bank of the Raritan River. Here it is transformed by three 75 kva. transformers (4160/440 volt deltadelta) and a single air-cooled 25 kva. unit (440/240/120 volt delta-wye) to

local power and lighting levels.

The third installed primary feeder is carried underground 1400 feet northeast to a distributing manhole located between the completed Wet Semi-Works building and the site of the main research laboratory. The underground duct system then branches to the primary switchgear room and to the sites of all proposed structures. This feeder system (extending over 1 mile in length) consists of series of 4-inch transite ducts (over 8,000 feet in all) spaced approximately 6-inches center-to-center and encased in a rectangular concrete envelope. Minimum burial depth of ducts is 2½ feet below Cables in all underground grade. ducts (lead covered) carry current at the primary level of 4160 volts, transformer stations in the various buildings reducing it to utilization levels.

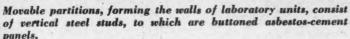
Elevation and plan of central section shows various types of lighting employed and location of switchgear, transformers, busduct, feeders and receptacle outlets.





feeder northocated Semiof the ınderies to nd to tures. ver } es of) feet nches recmum elow ound nt at ansuild-

ers.





Three phase, 3 wire, 2000-amp. busduct connects three 333 kva. single phase transformers (4160/480 volt delta-delta) to power switchboard.

In the Wet Semi-Works building, the power distribution system is 440 volts, 3 phase, 3 wire for all motors of ½ hp. and larger. Three 333 kva. transformers (4160/480 volt delta-delta) feed the main power switchboard. Nine power panels throughout the building supply current to ventilation fans, air compressors, elevator machinery, condensers, pumps and 440volt floor junction boxes. Also connected to the power switchboard, through six 700 MCM cables, is a 1000-amp., 3 phase plug-in busduct running the length of the factory area at a height of 20 feet and mounted on the high-bay side of the center line of columns. · Busduct is supported every five feet and sway-braced where necessary. Plug-in openings are located every foot on alternate sides. Connected to this busduct are the motors in the ten separate factory areas. Motor capacities range from fractional to 100 hp., the total motor load in the factory area connected to the busduct exceeding 2000 hp. An additional 270 hp. is connected directly to power panels. The ten factory areas containing these motors are devoted to asbestos fiber, transite pipe, asbestos cement, paper and millboard, board, shingles, asphalt products, material testing, magnesia, fillers and filtration.

The lighting system is 120/208 volts

a-c with 4-wire mains and two wire branches having grounded neutrals. Three 75 kva. units (440/120/208 volts delta-wye) are connected from the power switchboard by 3 phase, 3 wire, Oo-amp. bus and to the lighting switchboard by 3 phase, 4 wire, 800-amp, bus. Six air-cooled 37.5 kva. lighting transformers (440/120/240 volts) are connected to the plug-in busduct in the high bay factory area and are mounted on the steel columns approximately 16 feet above the floor level. Narrow column type lighting panels are mounted between column flanges directly beneath each dry transformer. Feeders between main lighting switchboard and distribution panels consist of four number 4's, feeders from plug-in busduct to high bay lighting transformers consist of two number 1's. As in the case of power distribution, the smallest branch lighting circuit consists of 12 gage wire. All lighting circuits over 100 feet in length are wired with 10 gage.

In general, all wire and cable is rubber insulated; wires of number 1 and smaller being type R, larger wires being type RH. Circuits connected to lighting panels are used for general lighting, receptacles, unit heaters, 120-volt junction boxes, tank feeders and a loud speaker system. Laboratory wall receptacle outlets, located in the

movable partitions, are connected to the 120-volt floor junction boxes by No. 10 wire in flexible steel conduit. With the exception just mentioned, interior wiring generally is in rigid steel conduit, \(\frac{3}{4}\)-inch or larger in diameter. Wires installed in floors under which there is no excavation, and branch circuits to outside lights, running in pipe tunnels and trenches, are lead covered.

Lighting of the factory area is by 1000-watt incandescent high-bay units mounted at a height of 25 feet and spaced 15 feet on centers (0.6 of mounting height). Light is directed downward by crystal glass prismatic reflectors and the loss of high angle light is minimized by controlled redirection. Due to the mounting height of the units and a shielding angle of 30 degrees, glare is negligible. Safety in mounting is insured by utilizing tripod holders to securely grip reflectors from the bottom (ice tong principle) and by specifying that reflectors be spun-sealed to covers so that, even though cracked, reflectors cannot drop. An intensity of 30 footcandles is achieved in this area with a consumption of 3.85 watts per square

Fluorescent lamps provide the source of illuminating the laboratories

[Continued on page 108]



The blue-white light from mercury vapor lamps in enclosed floodlights accents and distinguishes the tower of the New England Mutual building, making it a landmark on Boston's elite Boylston Street.

PROPER planning and use of special tools can simplify electrical maintenance. This has been proven by the Electrical Department of the New England Mutual Life Insurance Company of Boston. This department, consisting of the Chief Electrician and three electrical maintenance men, maintains and services all lighting equipment, motors, an internal telephone system, general wiring and electrical work in New England Mutual's home office building, Boston, Mass.

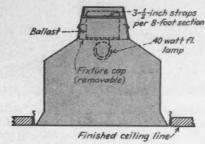
This office building is new, having been completed in the early part of the war. It consists of a central part ten stories high, and two wings each four stories high. The ground plot covers 65,750 square feet, with a total floor area of 437,000 square feet in the entire building. Elevator service is provided by four elevators arranged in two banks of two each on opposite sides of common lobbies. The entire building is air-conditioned. Internal telephone service is provided for by a 300-station automatic switchboard. Lighting is provided for all general office areas by single lamp 40 watt fluorescent open troffers installed flush in acoustic tile ceilings. Special fluorescent flush units with diffusing glass panels are used to light the main entrance lobby. The central tower is floodlighted at night by several 250 watt mercury vapor lamps in weather-

Office Building

Electrical maintenance is made easy through advance planning and development and use of timesaving tools in New England Mutual's new office building, Boston, Mass.

By George P. Forde
Chief Electrician

New England Mutual
Life Insurance Company of Boston



Cross section detail of special Smithcraft single lamp fluorescent troffer used for general lighting throughout building. Removable fixture cap simplifies maintenance of all auxiliaries.

proof enclosed floodlights located on

Electrical distribution, planned and installed by Hixon Electric Co., electrical contractors of Boston, is by means of a 120/208 volt, three phase, four-wire, 60 cycle system. A unique feature of this system is a grid layout of ceiling outlets spaced nine feet on centers, and installed on the slab above the suspended acoustical ceiling, in which all three phases and the neutral are carried to all outlets. The recessed troffer units are equipped with two-lamp ballasts for each eight foot length. These ballasts are then connected alternately to separate phases, so that all three phases are utilized in each general office space. This feature is particularly desirable when new partitions are installed, or old ones removed, as service is available at all ceiling locations for new troffer units. Old units can also be disconnected easily and removed all without the necessity for costly overhead wiring changes. Use of all three phases in each office area also reduces stroboscopic effect from fluorescent lamps to a minimum. Floor outlets provide 120 volt service at convenient locations for all electric operated business machines, water coolers, floor polishers, and similar electrical equipment.

One of the first steps made in planning for the maintenance of this new building was to set up a program for lighting maintenance and lamp replacement. It was decided to replace lamps, in general, only as they burn out or become unduly blackened. An exception to this rule is the lighting in executive offices and hard-to-get-at equipment, such as in the fixtures over the main entrance lobby. Here, all lamps are replaced as a group on a periodic basis, usually once a year, or at the end of 2000 hours of operation. The lighting equipment is washed and cleaned on an annual basis, which has proved adequate because the building is air conditioned and not subject to bad dust and dirt accumulation.

The fluorescent troffers, consisting of over 40,000 linear feet, were designed specifically for this building, and were made by the Smithcraft Lighting Division of A. L. Smith Iron Company, Chelsea, Mass. The use of this one design throughout all floors made it possible to develop special time-saving tools to be used in relamping and general maintenance.

Since it was planned to replace lamps only as they burn out, a oneman light step-ladder was developed for this purpose. This ladder permits replacement of lamps during normal office hours as the burn-outs are re-

MAINTENANCE



After fixture cap, which holds ballast, lampholders, starter switches and starters, is removed from troffer, two special rod hooks hold cap in place while maintenance men inspect parts and wiring.

ported to the electrical department. A supply of new lamps are dated with a standard rubber stamp, then placed in the lamp rack on the back side of the ladder each morning. As reports of burn-outs come in, an electrician shoulders the ladder and proceeds to the department making the report. Here he places the ladder where the lamp can be reached, and then first checks the starter switch. If the starter is in good condition, he removes the old lamp from the troffer and slides it into the ladder rack and funnel-shaped guard which guides the lamp into its proper position. Design of the ladder, with the lamp rack conveniently located, makes it possible for the electrician to make a complete inspection and replacement by climbing the ladder only once. He then takes a new lamp from the rack and inserts it in the fixture. If the lamp lights, he removes the ladder and proceeds to another department. If the lamp fails to light, he again checks the starter switch. Should the lamp continue to fail to light, the electrician reports this to the electrical department so that a two-man crew with more complete facilities for testing and checking may be dispatched to the department to look for defects in the ballast or wiring.

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There are over 10,000 fluorescent lamps in use throughout the building. All are of the hot cathode type, requiring separate starter switches. The

electrical department has standardized on manual reset starters to prevent continued blinking of lamps which fail to start after several attempts. It soon became apparent that a test board was needed to test lamps and starters. Parts were purchased, including a voltmeter and an ammeter, and a test board was then constructed. It is designed to test fluorescent lamps in sizes varying from 15 to 40 watts, and starter switches. New lamps are tested on this board before they are dated, to insure proper operation when installed, and to prevent unnecessary searching for trouble which would occur when defective new lamps are installed and fail to light.

When trouble develops within the troffer units, it is necessary to get into the wiring compartment in order to inspect the wiring, ballasts, lampholders, and starter switch sockets. Special tools were designed to make this job easy. For example, the troffer unit embodies a removable fixture cap in the top, which closes the wiring compartment when in place, and to which all wiring devices and ballasts are attached. This fixture cap is made in eight foot lengths, to accommodate two 40 watt lamps and all auxiliary equipment. It snaps into position and is held in place through normal spring pressure of the metal, aided by grooves in the cap and in the fixture



Maintenance of lighting equipment is made easy through use of special tools developed by the Electrical Department. This view shows special tool used to pull fixture cap from fluorescent troffer.

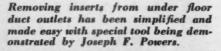
Chief Electrician George P. Forde tests a fluorescent lamp on test board. Note special tools on rack installed on wall at left of test board.



To remove a fixture cap from the troffer housing requires considerable pull. A simple "puller," utilizing the lever principle, make this task an easy job. Once the fixture cap has been pulled loose by this "puller," it is then supported about a foot below the ceiling by two special ½-inch steel rod hooks which are bent at one end to properly fit the fixture cap and hold it in a horizontal position, and formed at the other end to fit over a cross-brace strap in the wire raceway at the



When ballasts or parts are defective, entire fixture cap (wiring channel cover) is taken to work shop for test and repair or replacement. Note U-shaped blocks which hold fixture cap for Howard Terhune, electrician, and facilitate repair work.







One-man ladder, which holds new lamps and has space for old lamps removed, is used to replace individual burned-out lamps.



The electrical department maintains the internal house telephone system, and makes all telephone installations and changes.

top of the troffer. This feature gives the maintenance men complete freedom to make an inspection and test of all parts and to locate any faults in the equipment. When parts are found to be defective, the two lead wires are disconnected and the fixture cap is removed and taken to the electrical work shop where all parts can be removed, carefully tested, and repaired or replaced as required.

Another simple yet handy tool was made to support the fixture cap in any desired position on the work bench. This tool is a U-shaped support made from a two-inch thick wood block (upper L.). Two supports are used, one at either end of the fixture cap. Corners of the blocks are cut at a 45-degree angle, so that the fixture cap can be held in any convenient position in 45-degree steps. The fixture cap slides into and is held snugly by the inside of the U which is in these wood blocks.

A special portable scaffold was developed, capable of holding two men, to be used in servicing the lighting troffer units, air conditioning outlets, and other similar jobs requiring such a scaffold. Made of iron pipe and fittings, it is supported on four legs each equipped with 3-caster feet so that it may be rolled into place. Dimensions are such that it can be rolled through -all doorways and into elevators. Cross supports are high enough to permit it to straddle over desks or tables. Twoinch thick boards form a work platform. Its portability and careful design with respect to size makes it one of the most valuable tools in the shop.

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Removal of service fittings from Walker underfloor duct has been made easier by development and use of a special extraction tool, designed to quickly and easily remove the supports from the underfloor duct. This tool consists of a piece of five-inch pipe, about six inches long, cut out on one side so that the pipe can be slipped into place after a reverse scissors attachment, equipped with notches on the outside, is attached and locked in place by means of a key pin. This attachment is threaded onto a 5-inch rod which holds a five-inch washer and hexagonal nut. To release the locking ring the washer is placed on the top end of the puller and the nut tightened. This action exerts a pull on the ring, and the pressure will soon release the tightly fitted support. A handle has been attached to the puller so that it can be carried easily to any location where needed.

Careful planning, and the development and use of time-saving tools has streamlined maintenance and repair work so that all equipment is kept working at top efficiency. Cost figures, maintained by the Building Superintendent, indicate that this method of operation is economical and highly successful. Lamp life is averaging more than a year's operation. Ballast replacements were numerous during the first year of operation, due primarily to little experience in the production and use of ballasts at that time. These replacements are now less than one percent per year.

A. B. Lovatt, Lovatt Electric Service, Hackensack, N. J.; George B. Lockwood, Lockwood Electric Motor Service, Trenton, N. J.; Harry R. Herold, Tri-State Electric Motors, Inc., Troy, N. Y.; Patrick Gallagher, Patrick Gallagher Co., Kingston, New York.

NISA Convenes in DETROIT

LECTRIC motor repair shops are experiencing a disturbing "squeeze" between rising labor and material costs on one hand and new motor price ceilings on the other. To maintain profitable operation, shop leaders are reverting to more efficient repair techniques, more effective management and sales practices, and more serious consideration of employee relations. How this is being accomplished in various shops throughout the country was revealed at the 14th Annual Convention of the National Industrial Service Association at Detroit, March 31-April 3.

More than 500 registrants found much food for thought in the 26 conference papers and reports presented at the four-day session. All saw numerous new labor saving equipment and material items displayed by 18 exhibitors; many took advantage of a one-day tour of Detroit shops to see some of the conference ideas in actual operation.

An entire session was devoted to a discussion of Profits and Costs, topics of the hour. Members using Vaughen's Electric Motor Repair Pricing Guide were given an insight into its develop-

Shop efficiency, cost analyses, management problems and the copper situation highlight agenda at National Industrial Service Association Conference.

ment and the basis of its suggested prices.

The possibility of establishing flat rate systems for all electric motor repairs was raised by Earl M. Taber, general service manager, Pontiac Division, General Motors Corporation. Explaining the development and operation of such a system in the automotive repair industry, Taber expressed his conviction that a similar method, based on time studies of basic operations and adjusted to cover "average" mechanics ability, could be used to establish a standard pricing program that would eliminate much customer confusion in the electric motor repair field. Flat rate time allowances when multiplied by hourly wage rates prevailing in specific areas, establish the selling price, he asserted. Although this system is used in some cases for

fractional horsepower motor repairs, many shop men believe it could be extended to larger units.

Only by making a complete cost analysis of your business can you be assured of profitable operation, stated William Giles, Giles Armature & Electric Works, Marion, Illinois. Frequently the profit picture of motor repair operations is confused by combining repairs, equipment sales and even construction work into a single bookkeeping operation, he asserted. A careful analysis of separate operations often reveals that the motor repair department, with its low material to labor cost ratio, returns a substantial gross profit that offsets the narrow material sales profit on the combined balance sheet. Unless analyzed separately, many motor repair activities may appear unprofit-

R. V. Mills and T. C. Young, Anderson-Young Electric Co., Lubbock, Texas. (left photo)

H. F. Trester, Trester Service Electric Co., Milwaukee, Wis., F. Maurice Holt, Holt Electric Motor Service, Milwaukee; J. J. Rick, Rick & Selleg, Chicago, Illinois.













Clarence Wittmer, Emerson Electric Co., St. Louis, Mo.; F. M. Mielke, Mielke Electric Works, Duluth, Minnsota.

E. J. Ther, Ther Electric & Machine Works, Chicago, Ill.; W. H. Gruger, Phoenix Electric Co., Youngstown. Ohio.

Fred B. Wipperman, NISA Executive Secretary, St. Louis, Mo.; R. E. Ward, Electric Motor & Repair Co., Raleigh, N. C.

Charles B. Kaska, Chicago Electric Co., Chicago and J. P. Davis, manager, magnet wire sales, Anaconda Wire and Cable Co., Chicago.



M. G. Miller, Tennessee Electric Motor Service, Knoxville; Clarence Wittmer, Emerson Electric Co., St. Louis, Mo.; L. L. Egleston, Egleston Electric Co., Marshalltown, Iowa.

Alphonse Grinis, Federal Electric Products Co., Newark, N. J.; Glenn Buschman and Stanley Newhard, Kirby Risk Electric Service, Lafayette, Indiana.



J. G. Hupp, Electric Motors Co., Cedar Rapids, Iowa; W. M. Hogue, R. A. Reed Electric Co., Los Angeles, Calif.; H. Ed. Grant, Tennessee Electric Motor Service, Nashville.

able to the owner who takes an overall view of his business operation, Giles warned.

Profit percentages indicated in past NISA Sales Survey Reports are much too low for business operations in the \$200,000 volume and under category in the estimation of M. G. Miller, Tennessee Electric Motor Service, Knoxville. If this is true, then the costs must be too high, he reasoned, and shop operations bear investigation. Miller believes a net profit (before taxes) of 14.4 percent is reasonable for the small shop doing all service work and suggests the following general percentage cost pattern: Productive labor -36.8; raw material-23.9; operating overhead-7.5; operating expenses-0.56; housing overhead-0.84; administrative and sales overhead-13.6: transportation overhead-2.4.

How much is a motor shop executive worth? Wm. H. Braunlich, Braunlich-Roessle Co., Pittsburgh, suggests that executive ability and salary should be determined by: (1) the size of the operation to be managed—annual sales, payroll less executive salaries and net worth; and (2) the executive's ability to show a profit. Size, factor should count two-thirds and profit earning capacity one-third in actual salary calculations, he contended, illustrating his talk with two executive ability evaluation charts de-

George F. Mann, Commonwealth Service Sales Corp., Detroit, Mich.; Selden F. High and Albert C. Hanson, The Sullivan Electric Co., Cincinnati,

veloped by the NISA Research Division for both small and large shops.

Five papers were presented at the small motor shop session. Jeff Gray, merchandise manager, electric motors, United Motors Service, Detroit, reviewed the new NEMA program of standardization for fractional horse-power motors designed to reduce production cost, insure efficiency and proper application and result in long-term savings to customers.

Keep an adequate stock of parts to service the small motors in your specific area, advised A. H. Barrere, Jr., Russell Electric Co., Inc., Mobile, Alabama. Maintain this stock through a simple Cardex or visible inventory control system and reduce parts department "trips" to a minimum for efficient operation, he added.

Volume is the lifeblood of small motor shops operation asserted M. G. Miller, Tennessee Electric Motor Service, Knoxville specialized small motor repair firm. Unless you are prepared to set up a separate department, stay away from universal type motors (portable electric tools, etc.), he warned.

Easiest method of showing a profit on small motor repairs is to utilize latest equipment and special tools to reduce unit cost, stated George Baumgardner, Independent Electric Motor Company, Cleveland. Operating on

Wm. A. Wheeler, The Maintenance Co., New York City; J. Roland Stolzenbach, The Roland Electric Co., Baltimore, Md.; John R. Lange, Lange Electric Co., Baltimore.









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George B. Svendsen, Boustead Electric & Mfg. Co., Minneapolis, Minn.; John E. Giles, Giles Armature & Electric Works, Marion, Ill.

Leonce Bonnecase, Best Electric Co., New Orleans, La.; Roland B. Glines, Roland B. Glines Co., Lawrence, Mass.

Ex-Governor Carl E. Bailey, Little Rock, Ark.; and State Senator Ellis Fagan, Fagan Electric Co., Little Rock,

Frank W. Sloan, California Electric Works, San Diego, Calif.; Paul Leicht, Empire Electrical Co., Cambridge, Arkansas.

this theory, Baumgardner's shop showed a 30.4 percent labor cost and 39.2 percent parts and materials cost on a \$100,000 gross annual volume of repair work only.

Selecting and training personnel is one of the most important problems facing the small motor shop operator, stated C. A. Morris, Southern Electric Service, Charlotte, N. C. Based on past experience, he finds that young men between 18 and 25 years and women between 25 and 35 years work out best. Careful study of the applicant's capabilities and temperament, the type of instruction best suited for him (shop training and/or theory) and earnest instruction, supervision and encouragement is the best formula for employee training, Morris believes. Couple this with an efficient shop layout that eliminates lost motion and you are well on the road to successful operation, he concluded.

Problems in industrial electrical equipment service shops were reviewed in six papers presented at a separate session.

Reiterating previous expressions that efficient shop methods bolster profits, Paul Potter, Jr., Potter & Rayfield, Inc., Atlanta, Ga., commended the shops for developing numerous devices to boost output, but urged them to take their coil winding problems to the various equipment manufacturers

for quick and economical solution.

Of all shop divisions, the coil making department has the greatest bearing on profits, asserted Larry L. Alldritt, Alldritt Electric Motor Company, Miami, Florida. Don't make the mistake of using unskilled help on this work, he cautioned. Alldritt believes the future will bring a larger percentage of stator winding hence the need to concentrate on efficiency in this department.

Completing the shop techniques discussions, Roy Spaulding, Spaulding Electric Co., Detroit, outlined an extensive motor testing scheme used in his shop. C. B. Stainback, Westinghouse Electric Corp., presented an illustrated resume of the theory and application of high frequency heating in industry.

Every motor shop operator is aware of the critical shortage of magnet wire. Why such a shortage has developed was explained by George H. Brown, president, Insulation and Wires, Inc., St. Louis, in a comprehensive paper covering the background, statistics and factors affecting copper and magnet wire production. Last year the U. S. used 1,260,000 tons of copper of which 660,000 tons was foreign copper. In 1947, various estimates indicated a demand of 1,400,000 to 1,800,000 tons.

By the end of April the government Metal Reserve Corporation will de-



F. H. McKerney, Hotel Statler, Detroit; Charles J. Cannon, A. H. Nimmo Electric Co., Detroit; Wm. H. Braunlich, Braunlich-Roessle Co., Pittsburgh.

G. E. Jones, G. E. Jones Electric Co., Amarillo, Texas; Frank W. Willey, Willey-Wray Electric Co., Cincinnati, Ohio.



C. L. Kienbortz, Electric Motor Shop, Springfield, Ill.; L. R. Bradford, Bradford Electric Works, East St. Louis, Mo.; Stanley Kroell, Kroell Electric Co., Canton, Illinois.

T. L. Rosenberg, T. L. Rosenberg Co., Oakland, Calif.; Fred S. Ferris, Northeastern Electric Co., Boston., Mass.

A. H. Barrere, Jr., Russell Electric Co., Mobile, Ala.; N. G. Welch, Electric Service, Inc., Nashville, Tenn.; Earl E. Wright, Dixie Industrial Service, Chattanooga.









W. T. Becton, Electrical Equipment Co., Raleigh, N. C.; H. L. (Slick) Phillips, Southern Electric Service, Charlotte, N. C.; George Sachsenmaier, Keystone Power Plant Equipment Co., Philadelphia.



H. A. Holden, H. A. Holden, Inc., Minneapolis, Minn.; H. O. Hale, The Helwig Company, Milwaukee, Wis.; John Cole, The Helwig Company, Oklahoma City; E. E. Boyles, Service & Supply, Amarillo, Texas.



A. R. Swick, Southern Armature & Motor Works, Knoxville, Tenn.; Jim Steffner, Chattanooga Armature Works, Chattanooga, Tenn.; B. S. Woodman, Potter & Rayfield, Inc., Atlanta, Ga.; S. U. Steffner, Chattanooga Armature Works.

J. Friedman and J. A. Hillman, Wheeler Service, Inc., Cambridge, Mass.; A. S. Tracy, A. S. Tracy Co., Concord, New Hampshire.



liver 69,000 tons—all of its remaining stockpile—to fabricators. Total copper production—domestic, foreign purchased and stockpile—for 1947 will approximate 1,150,000 tons leaving a shortage of from 250,000 to 650,000 tons, Brown asserted. Even with the elimination of the four-cent per pound tariff on import copper, this will mean that motor shops will get only two-thirds of their requirements. Next year the supply of magnet wire will be about at prewar levels but only about 70 percent of user's demands, Brown added.

With the price of copper jumping from the OPA 12-cents per pound level to 21½ cents per pound on March 3, Brown expects an increase to 25 cents per pound by fall. Compared to the present magnet wire base of \$31.88 cwt, Brown sees a \$36.00 cwt base by fall.

That management's attitude toward the employee looms as a sizable front office problem was evident from discussions at a session devoted to this subject.

You cannot consider manpower as horsepower, stated Wm. J. Wheeler, The Maintenance Co., New York City. Unless the facts are made known, the worker cannot understand the large spread between his hourly wage and the charge to the customer, he pointed out.

Discussing incentive and pension plans, ex-governor Carl E. Bailey, Little Rock, Arkansas, asserted that profits should go to those (management and labor) whose efforts made possible production and to whom a share of the profits will be a stimulus to greater production.

While brilliant in development of machines, materials, and methods, management is weak in the handling of men, stated F. W. Willey, Willey-Wray Electric Co., Cincinnati. create harmonious and successful team play, he believes management should: (1) establish a pay rate that is a measure of the overall contribution of the worker-based on job evaluation and merit rating; (2) respect the intelligence of the American worker and let him "know the score" about company operations (3) recognize meritorious performance by spoken word and financial reward; (4) workers establish retirement estates of some sort to keep them free of doles.

Winners of the 1947 NISA Award Contest were announced at the convention. First prize of \$150 was

(Continued on page 147)



Charles E. Johnson, Universal Electric Products, Detroit; E. C. Burke, Cluchey Brothers, Flint, Michigan.



F. R. Hannon, Hannon Electric Co., Canton, Ohio; W. L. Bowler, United Motors Service, Detroit, Michigan.



Charles D. Hills and John Pfeil, Koontz-Wagner Electric Co., Inc., South Bend, Indiana.

Milton Volcker, Carbon Engineering, Inc., Flushing, L. I.; Robert H. Brown, Alfred L. Brown Associates, Inc., Worcester, Mass.



UTILITIES Back Planned Lighting

NTEGRATION of industry sales effort toward better lighting practice is the core of EEI's "Planned Lighting Program." Organized by the Edison Electric Institute in cooperation with the Better Light—Better Sight Bureau, the program brings utility support and broad gage promotional activity into an all-industry attack on the lighting market.

The program was announced at the spring commercial meeting of EEI by J. S. Schuchert of the commercial sales section of EEI and Harry Restofski, chairman of the BL-BS Bureau. Under the slogan, "Planned Lighting Means Profitable Load," it is attracting strong utility support. Plans are under way to enlist the cooperation of all branches of the industry so that sales efforts may be integrated and supported by the educational and promotional materials which have been prepared. While it is intended that the utilities will form the spearhead, the program is flexible and can be employed nationally or locally by manufacturers, contractors or distributors as well.

The nub of the promotion is an appeal to customers to have their new lighting planned before they buy it and offers this service through the lighting salesman as "the Man who Plans" at no cost to them. Supporting educational material by BL-BS is five times greater than any previously prepared. More than 30 different lighting educational aids covering applied lighting for seeing tasks in homes, schools, offices and factories are designed to supply the groundwork for planned lighting sales efforts.

The program is detailed in six books. One of them is being distributed to top utility executives carrying to them the reasons why the program is being undertaken and explaining its importance to the electric utility industry. It is supplemented by five books dealing with the five major lighting markets—residential, stores,

Edison Electric Institute Campaign will foster sound lighting design and application through industry-wide cooperation, education and promotion.

offices, schools and industrial plants.

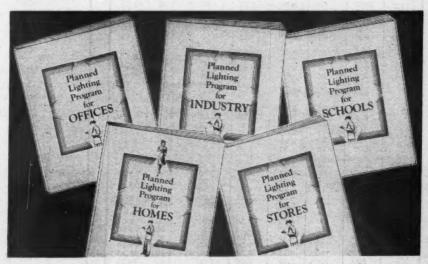
Each of the five supporting volumes details the characteristics of the market it describes. Indications of potential revenue which may be derived through organized sales effort are included, along with the sales organization and operating methods best suited for successful selling of lighting in each of these fields. Samples of advertising and promotional material, prepared specifically for each major lighting field, also are included in each supporting volume. All-promotional materials offer the free "Planned Lighting" service and enlarge the theme of the entire program - "The Man Who Plans."

The store lighting plan book attacks the problem from all sides. It presents a series of twelve direct mail pieces; a consumer booklet studded with lighting modernization ideas; a sample of the "Planned Lighting" layout form; several suggested newspaper advertisements and a sales visualizer, to arm salesmen for customer contacts.

Both the new and existing home markets are the target of educational and promotional appeals in the residential "Planned Lighting" program. Aimed at the new home market are materials which include a prospectus directed at the speculative builder, a booklet explaining lighting and wiring, and a number of special direct mail pieces. For the existing home market, booklets explain numerous lighting modernization ideas. They are supplemented with an extensive series of direct mail pieces.

Other sales tools for the residential "Planned Lighting" program include exhibits, demonstrators and other types of sales helps. Point-of-sale merchandising material will include a

(Continued on page 108)



Five booklets, each covering one of the five major lighting markets, outline in detail the promotion of planned lighting.

POLYPHASE REWIND TIME SCHEDULE (NISARD Bulletin 223)

For Mush Wound Coils

Motor Data			Time In Hours				
Rating H.P.	Speed R.P.M.	Number of Slots	Disas., Strip- Clean	Make Coils, Cut Insul.	Insulate, Wind, Connect, Dip, Bake	Assemble, Test, Paint	Total
34	3600	24	0.75	1.25	3.50	1.25	6.75
	1800	24	0.75	1.25	3.00	1.25	6.25
	1200	36	0.75	1.25	3.25	1.25	6.50
34	3600	24	0.75	1.25	3.50	1.50	7.00
	1800	24	0.75	1.25	3.00	1.50	6.50
	1200	36	0.75	1.25	3.25	1.50	6.75
1	3600	24	0.75	1.25	3.50	1.50	7.00
	1800	24	0.75	1.25	3.25	1.50	6.75
	1200	36	1.00	1.50	3.50	1.75	7.75
	900	48	1.00	1.50	4.00	1.75	8.25
11/2	3600	24	0.75	1.25	3.75	1.50	7.25
	1800	24	0.75	1.25	3.50	1.50	7.00
	1200	36	1.00	1.50	3.75	1.75	8.00
	900	48	1.00	1.50	4.25	1.75	8.50
2	3600	24	1.00	1.25	4.00	1.75	8.00
	1800	24	1.00	1.25	3.75	1.75	7.75
	1200	36	1.00	1.50	4.00	2.00	8.50
	900	48	1.25	1.50	4.50	2.00	9.25
3	3600	24	1.00	1.25	4.25	2.00	8.50
	1800	36	1.00	1.50	4.25	2.00	8.75
	1200	48	1.25	1.50	4.25	2.25	9.25
	900	48	1.25	1.75	4.75	2.25	10.00
5	3600	24	1.25	1.25	4.50	2.25	9.25
	1800	36	1.25	1.50	4.50	2.25	9.50
	1200	48	1.25	1.75	4.75	2.50	10.25
	900	48	1.50	1.75	5.00	2.50	10.75
71/2	3600	94	1.50	1.50	5.00	2.25	10.25
	1800	36	1.50	1.75	5.00	2.25	10.50
	1200	48	1.50	2.00	5.25	2.50	11.25
	900	48	1.75	2.00	5.50	2.50	11.75
10	3600 1800 1200 900 720	24 36 54 72 72	1.75 1.75 1.75 2.00 2.25	1.50 1.75 2.25 2.50 2.75	5.50 5.50 5.75 7.00 7.50	2.50 2.50 2.75 2.75 2.75 2.75	11.25 11.50 12.50 14.25 15.25
15	3600	24	2.00	1.75	6.00	2.50	12.25
	1800	36	2.00	2.00	6.00	2.50	12.50
	1200	54	2.25	2.25	6.50	2.75	13.75
	900	72	2.25	2.50	7.50	2.75	15.00
	720	72	2.50	2.75	8.00	3.00	16.25
20	3600 1800 1200 900 720 600	36 48 54 72 72 72 96	2.25 2.25 2.50 2.50 2.75 2.75	2.25 2.50 2.50 3.00 3.25 3.75	6.50 6.50 6.75 8.00 8.50 9.50	2.75 2.75 3.00 3.00 3.25 3.25	13.75 14.00 14.75 16.50 17.75 19.25
25	3600	36	2.50	2.25	7.00	3.00	14.75
	1800	48	2.50	2.50	7.00	3.00	15.00
	1200	54	2.75	2.75	7.50	3.25	16.25
	900	72	2.75	3.25	8.50	3.25	17.75
	720	72	3.00	3.50	9.00	3.50	19.00
	600	108	3.00	4.25	10.50	3.50	21.25
30	3600 1800 1200 900 720 600	36 48 54 72 90 96	3.00 3.00 3.25 3.25 3.50 3.75	2.50 2.75 3.00 3.50 4.00 4.75	7.50 8.00 8.50 9.50 10.00 12.00	3.50 3.75 3.75 4.00	16.50 17.25 18.50 20.00 21.50 24.50
40	3600 1800 1200 900 720 600	36 48 54 72 90 96	3.50 3.50 3.75 4.00 4.25 4.50	2.75 3.25 3.50 4.00 4.50 5.00	8.00 9.00 9.50 10.75 12.00 13.00	4.00 4.25 4.25 4.50	18.25 19.75 21.00 23.00 25.25 27.00
50	3600 1800 1200 900 720 600	36 60 72 72 72 120 120	4.00 4.00 4.25 4.50 4.75 5.00	3.00 4.00 4.25 4.50 5.25 5.50	8.50 10.50 11.00 12.50 14.00 15.00	4.50 4.75 4.75 5.00	20.00 23.00 24.25 26.25 29.00 30.50
75.	3600 1800 1200 900 720 600	36 60 72 72 72 120 108	4.50 4.50 4.75 5.00 5.25 5.75	3.50 4.50 5.00 5.00 6.00 6.00	9.00 11.50 12.00 14.00 15.00 17.00	5.00 5.00 5.25 5.25 5.50	22.00 25.50 27.00 29.25 31.75 34.25

Meeting

Suggested methods that will help you stay within or better the limits of the latest NISA Polyphase Rewind Time Schedule.

By S. U. Steffner

Chattanooga Armature Works Chattanooga, Tennessee

POLYPHASE REWIND TIME SCHEDULE (NISARD Bulletin 223) For Form Wound Coils

Motor Data				Tir	ne In Ho	Wrs	
Rating H.P.	Speed R.P.M.	Number of Slots	Disas., Strip- Clean	Make Coils, Cut Insul.	Insulate, Wind, Connect, Dip, Bake	Assemble, Test, Paint	Tota
20	3600	36	2.25	4.75	6.50	2.75	16.2
	1800	48	2.25	5.00	6.50	2.75	16.5
	1200	54	2.50	5.00	6.75	3.00	17.9
	900	72	2.50	6.00	8.00	3.00	19.50
	720	72	2.75	6.50	8.50	3.25	21.0
	600	96	2.75	7.50	9.50	3.25	23.0
25	3600	36	2.50	5.00	7.00	3.00	17.50
	1800	48	2.50	5.00	7.00	3.00	17.5
	1200	54	2.75	5.50	7.50	3.25	19.0
	900	72	2.75	6.50	8.50	3.25	21.00
	720	72	3.00	7.00	9.00	3.50	22.50
	600	108	3.00	8.50	10.50	3.50	25.50
30	3600	36	3.00	5.50	7.50	3.50	19.50
	1800	48	3.00	5.50	8.00	3.50	20.00
	1200	54	3.25	6.00	8.50	3.75	21.50
	900	72	3.25	7.00	9.50	3.75	23.50
	720	90	3.50	8.00	10.00	4.00	25.50
	600	96	3.75	9.50	12.00	4.00	29.25
40	3600	36	3.50	6.00	8.00	4.00	21.50
	1800	48	3.50	6.50	9.00	4.00	23.00
	1200	54	3.75	7.00	9.50	4.25	24.50
7	900	72	4.00	8.00	10.75	4.25	27.00
	720	90	4.25	9.00	12.00	4.50	29.75
	000	90	4.30	10.00	13.00	4.50	32.00
50	3600	36	4.00	7.00	8.50	4.50	24.00
	1800	60	4.00	8.00	10.50	4.50	27.00
	1200	72	4.25	8.50	11.00	4.75	28.50
	900 720	120	4.50	9.00	12.50	4.75 5.00	30.75
	600	120	5.00	11.00	15.00	5.00	36.00
75	3600	36	4.50	8.00	9.00	5.00	26.50
13	1800	60	4.50	9.00	11.50	5.00	30.00
	1200	72	4.75	10.00	12.00	5.25	32.00
	900	72	5.00	10.00	14.00	5.25	34.25
3-1	720	120	5.25	12.00	15.00	5.50	37.75
	600	108	5.75	12.00	17.00	5.50	40.25

Polyphase Rewind Time Schedules

DIVERSITY of opinions exist regarding the actual time required for different operations necessary to completely rewind a motor in shops specializing in large motor repairs. The National Industrial Service Association Research Division (NISARD) issued Bulletin 223 on March 20, 1947 presenting a Polyphase Rewind Time Schedule for motors with mush and form wound coils.

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Whether or not shops can meet this schedule is a matter of individual determination and investigation of shop techniques. Rather than dwell at length on the actual time schedule, I am going to suggest a few things you can do in your own shop which probably will lower the time factor, decrease the cost all the way through and hence add to your profits. Bear in mind, however, that the shop repairing only a few motors daily, either small or large, is at a disadvantage due to the initial cost of some of the time-saving methods outlined below.

The techniques presented are used in our own shop. We find that they enable us to keep within the time schedule limits on many operations. Perhaps they will help you meet or even better these limits. In the interest of clarity and conciseness, I will list our methods in the order in which rewind operations occur.

Disassembly

Dismantling and correctly marking various motor parts and accessories should be handled by a competent person. Though a comparatively simple step in motor repairing, it can greatly affect the time required to reassemble the job. Delivering a motor minus a pulley or base, or with the leads coming out of the wrong side does not contribute to customer good-will. Rectification of such errors may only take a few minutes, but they decrease profits.

We have a system that eliminates

many of these errors. Our receiving clerk fills out a tag bearing a job number which is also the control number for this specific job regardless of what repairs are necessary. After the indicated information is recorded, the center part of the tag is filed alphabetically, according to customer, for immediate reference. The tag indicates all extra equipment sent in with the motor and has duplicate numbers equipped with tie wires. When the motor is disassembled one tag is attached to the stator and the other to the rotor and end bells.

We center punch the pulley end bell and the corresponding position on the stator with two marks. We mark the opposite end bell and adjacent side of the stator with one punch mark each. If lead positions are not clearly indicated, we center punch three marks on the stator frame where leads are to be brought out. Should the motor require rewinding we supply a winding data card with all information. This card immediately goes to the coil winding department and is later attached to the completed set of coils.

Stripping and Cleaning

Considerable time is saved by the use of an electric roasting oven which we designed and built at a cost of about \$1600.00. The 44 in. by 54 in. by 66 in. unit (inside dimensions) contains six banks of strip heaters totaling 27 kilowatts. The oven is loaded each night and turned on for the burning cycle of 3½ hours which we found would roast the winding completely. The automatic time control turns off the current at the specified time and we remove cold motors in the morning. This procedure allows the stators to cool slowly, eliminating warping of frames.

Before stators are placed in the oven, one end of the winding is cut off close to the laminations with a special chisel operated in a small Chicago Pneumatic (CP-V2) scaling hammer. This facilitates removing the copper coils after the stator comes out of the oven. Before the frames leave

the stripping department, they are sprayed with a light coating of black insulating varnish to prevent rusting and to produce a better finish. With these methods, the time required to strip a stator and get it ready for winding averages 50 minutes.

Making Coils

Winding coils is an art within itself and you should have a separate department for making form and mush wound coils. Proper equipment is essential to efficient operation. Investment in the latest type of coil winding machines, spreaders, group winding heads, and taping machines is worthwhile. On large motor rewinds, considerable time can be saved by having the coil department group the coils before they are placed in the stator thus making it easier to make and insulate the stub connections. By doing this, we have experienced a saving of approximately 12 hours on a 600 hp. rewind job.

Rotor bars are made in our shop in a simple jig adjustable for any angle, span length and conductor length. Special jigs and forms are available for stamping out connectors to fit any size wire.

When a stator winder cuts his own insulation, it is an emergency. We have one man doing all the insulation cutting, forming, etc., for ten winders—and he does not expect a winder's pay. His developed proficiency in this operation saves considerable time and expense.

Winding, Connecting, Dipping

When we assign a winder to a job, we actually hand him a clean stator or armature, precut and formed insulation and a set of coils. The winder is our most expensive employee and we make his operation per job as short as possible. By doing this we are able to stay within the limits of Bulletin 223.

All our rotor bar connections are welded with phoscopper. To weld connectors without burning the bar

[Continued on page 113]

From a paper presented at the NISA Convention Detroit, Mich.

INDUSTRIAL LIGHTING

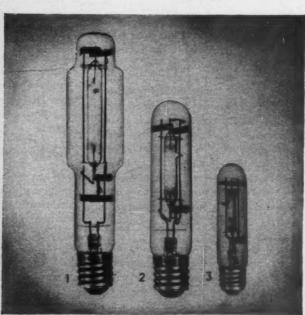
PART III—Lighting with Mercury Vapor Lamps

Enormous Navy blimp hangar is lighted with 42 3-kw. type A-H9 mercury lamps in reflectors suspended beneath a catwalk 133 feet above the floor.



Mercury lamps, with high lumen output per lamp and long life, offer advantages for many industrial lighting applications, especially in high bay areas and in heavy industries.





Popular sizes of mercury lamps for general lighting service. (1)-400 watt H1; (2)-250 watt type H5; (3)-100 watt type H4; and (4)-(at left) 3000 watt type A-H9.

ERCURY vapor light sources, commonly referred to as mercury vapor high intensity type H lamps, were at the height of popularity during the 1930's. This was prior to the introduction and subsequent development of the fluorescent lamp. Compared with incandescent lamps, mercury lamps were particularly well adapted to industrial lighting, and were used to some extent in offices and stores. Because of their initial high efficiency and longer lamp life, they were readily accepted by the public. Many of these installations are still in use, and are proving satisfactory and economical.

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As pointed out in Part II of this series (E.C.&M., April, 1947), fluorescent lighting has developed rapidly over the past eight years. It has logically become the popular answer for most industrial lighting applications. However, mercury vapor lamps

By Berlon C. Cooper

offer advantages and economies for many industrial lighting problems. One major reason for this is the high lumen output of single lamps, requiring a minimum of equipment and wiring for installation. Other factors which influenced the early popularity of mercury lamps included long lamp life, a whiter light than was produced by incandescent lamps, cool appearance, and greater economy in operation and maintenance.

Five sizes of mercury lamps comprise the standard line used for general lighting purposes. These are: 100 watt H4; 250 watt H5; 400 watt H1; 3000 watt H9; and a new 1000 watt lamp recently announced. Of these, the 400 watt size has been most popular. The 3000 watt lamp was used effectively to light large areas in war plants, and continues to be used for certain applications in heavy industries, especially high bay areas where maintenance dictates a small number of units be used.

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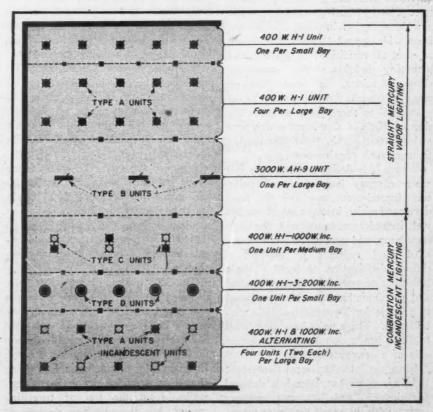
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Experiences gained during war years in lighting large areas with high ceilings with fluorescent lamps has indicated that standard wide spread type reflectors can be used successfully in medium to high bay installations. This has resulted in installing fluorescent standard reflector units at heights of 30 to 40 feet. This practice is being followed more and more. However, maintenance immediately becomes a problem, due to the large number of fluorescent units required to produce the higher footcandle levels demanded by industry. today. Careful studies of first costs, maintenance and upkeep of lighting systems will in most cases favor the 3000 watt mercury installations where high mounting and its inherent problems of maintenance are involved. Also, where maintenance is severe, as in steel mills and foundries, use of the 400 watt mercury lamp in suitable enclosed reflectors often offers advantages over open reflector fluorescent units. In general, mercury lamps are suitable for use in medium and high bay areas in the so-called heavy





Typical layouts for reflectors using mercury vapor lamps only, and for combination mercury-incandescent lamps. Bay area sizes are considered as follows: small bays—under 16 feet wide and long; medium bays—16 to 24 feet wide and long; and large bays—over 24 feet wide and long.

flector unit (1-400

watt mercury, 1-1000 watt incan-

descent).



Combination mercury-incandescent units provide 22 footcandles average in Textile Machine Works plant, Reading, Pa. Each unit in high bay area houses one 400 watt type H-1 mercury lamp and three 200 watt incandescent lamps. Units in low bays each house one 100 watt type AH-4 mercury lamp and three 100 watt incandescent lamps.

industries, such as in steel mills, foundries, die-casting shops, machine shops, metal stamping plants and similar metal working areas.

Lighting Equipment. In general, standard industrial reflectors of the 1000 watt incandescent size, altered only to provide greater ventilation and dissipation of heat, are used to control the light distribution of the 400 watt H1 lamp. Prismatic glass, porcelain enamelled steel, aluminum and silver mirrored glass are all used as reflectors. These reflecting materials permit a wide variation in light distribution from wide spread to intensive, ample to meet all conditions of spacing and mounting heights. For extremely dirty locations, a steel housing equipped with heat-resisting cover glass utilizes three types of inner reflectors made of aluminum, which provides variations in light distribution to meet such requirements.

Where it is desirable to use the 400 watt mercury lamp in combination with incandescent, one unit has been developed which incorporates three 200 watt incandescent lamps with the mercury lamp, and uses a porcelain enamelled steel reflector to produce a diffuse distribution of light. Angle reflectors of porcelain enamelled steel and aluminum have also been produced to provide for asymmetrical light distribution. These units have been used to light production lines from either side of a conveyor system.

Since the introduction of fluorescent lighting, there has been less demand for the 250 and 100 watt mercury lamps, with the result that most manufacturers have discontinued their lines of reflector equipment for these lamps.

Large porcelain enamelled steel re-

flectors have been used successfully with the 3000 watt mercury lamp, as well as large open type aluminum reflectors. New designs of reflectors are now under consideration, and will probably be announced soon.

Color Quality. Mercury lamps produce light from a mercury-vapor arc, hence the color of the light is primarily in the blue-green-yellow portion of the spectrum. This combination gives the effect of a much whiter light than incandescent. It is preponderantly bluish green, however, and is objected to by many for this reason. The color quality is excellent for high visual acuity in viewing metals, such as castings, machined parts, etc. To overcome the bluish green effect of mercury lighting, incandescent light is often mixed with it, to add enough yellow and red light to the mercury light to give a closer approximation of daylight.

Lighting Layouts. Where mercury lamps only are used, individual units are normally spaced one to a bay in small bay areas, or four to a bay in medium or large bay areas, based on the 400 watt type H1 lamp. Symmetrical spacing of outlets is usually desirable.

The 3000 watt H9 lamp is normally installed 30 feet or higher from the floor, and one unit per medium bay area. In larger bays four units per bay are recommended, depending upon the total level of illumination desired. Provisions for relamping and servicing should be provided, by means of catwalks, from the top of travelling cranes, by disconnecting devices or other structural or mechanical means.

Three layout techniques are used for combining mercury lamps and in-

candescent lamps in order to improve the color quality of the lighting result One technique is to use a combination mercury-incandescent reflector unit, and install one unit per small bay, or four units per large bay. A second technique is to use a two-reflector unit. in which one reflector is equipped with a mercury lamp, and the other reflector is equipped with an incandescent lamp. The third technique is to use mercury lamps in alternate reflectors, and incandescent lamps in the intermediate reflectors. These various layouts are shown in the accompanying illustration. Care should be exercised to select the proper type reflectors to provide a light distribution so that the work plane is uniformly lighted with either the incandescent or the mercury lamp reflector units.

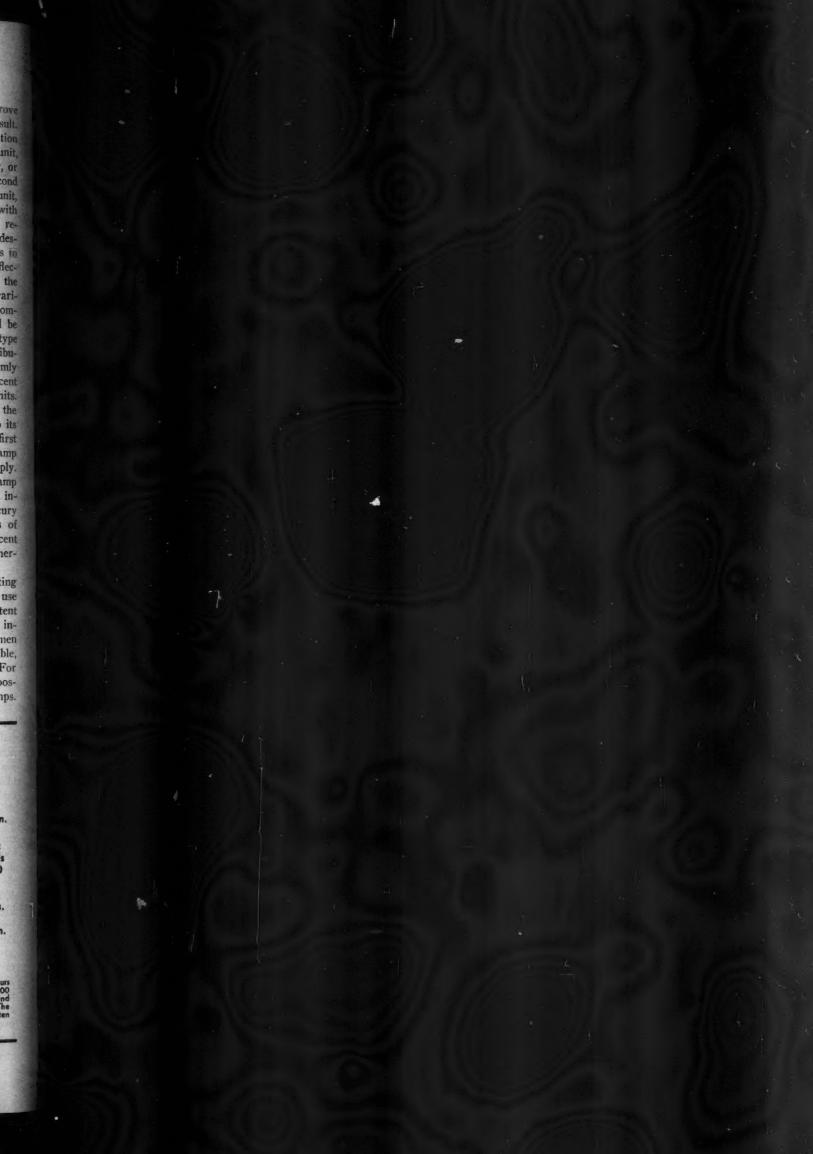
One fault of the mercury lamp is the time required to bring the lamp to its full brightness when the unit is first turned on, or in restarting the lamp after an interruption in power supply. This disadvantage of the mercury lamp is another reason for combining incandescent lighting with the mercury lighting system, so that in cases of power interruption the incandescent lamps will provide light until the mercury lamps can be relighted.

Because of the time lag in starting or restarting mercury lamps, their use is not recommended for intermittent service. However, there are many industrial areas where a high lumen output lamp of long life is desirable, and offers economies of operation. For such areas, it is well to study the possibility of the use of mercury lamps.

TABLE I

Essential Mercury Lam			
	Essential Me	rcury Lar	np Data
		H1	H9
	Average lamp watts	400	3000
	Bulb diameter	2 in.	1 3/16 in.
	Base	Mogul	Single Contact Terminals
	Average initial lumens	40	120,000
	Lumens per watt	40	40
	Average life rating*	4000 to 6000 hrs.	3000 hrs.
	Maximum over- all length	13 in.	54 7/8 in.
	Length of light	6 in.	48 in.

* Lamp life is influenced by the number of hours burned per start. The H1 lamp is rated at 4000 hours life when burned five hours per start, and 6000 hours when burned ten hours per start. The H9 lamp is rated at 3000 hours life based on ten hours burning per start.





1950-1960

The Twentieth Century Fund, a privately-endowed research foundation, has just completed a monumental 875-page work called "America's Needs and Resources." In it is presented a detailed preview of

what economic life in the U.S.A. during the 1950-60

decade will be like if we succeed in maintaining high-

level employment. From the findings of the Twentieth Century Fund survey, the McGraw-Hill Department of Economics has prepared this synopsis, which high-lights points of interest to mendous of this management.

lights points of interest to readers of this magazine.

MORE PEOPLE WORKING ...

1940

EACH PRODUCING MORE ...

CAN TURN OUT ENOUGH GOODS AND SERVICES.

FOR CONSUMERS, CAPITAL INVESTMENT AND GOVERNMENT

WITH THE RESOURCES AVAILABLE ...

TO MEET ALMOST ALL OUR NEEDS

POPULATION

MORE PEOPLE

WORKING ...

A nation's wealth depends more than anything else on the size and vigor of its population. Much of the increase in U. S. production during the past hundred years is a result of a rapid growth in population. This growth supplied manpower for farms and factories

and provided an expanding market for con-

sumer goods and services.

Growth was the outstanding fact about population before 1930. The birth rate was almost double the death rate and there was a heavy flow of immigrants. Between 1900 and 1930, the population increase averaged 15 million each decade. Immigration contributed a third of the increase.

But this trend was checked by the depression 30's which stemmed the flood of

immigrants and cut the birth rate by forcing postponement of many marriages. As a result, fewer than 9 million persons were added to the population between 1930 and 1940. This was an important factor in prolonging the depression because it slowed the growth of consumer markets,

WARTIME MARRIAGE BOOM

War and postwar conditions have brought a boom in marriages. They have exceeded normal by more than 1,500,000 since 1940. There will be more newly-married couples in 1950 than ever before and the birth rate may be roughly 10% higher than in the early 1930's. So the 20th Century Fund looks for an increase of 12 million in total population between 1940 and 1950 and a further increase of 10 million in the 1950's.

This will mean a faster-growing market for homes, autor, food, clothing, and other consumer items than we had in the 1930's. It will mean crowded schools and more people seeking jobs.

There are four major population trends which will

affect markets in the 1950's:

1. The number of families will continue to increase more rapidly than the number of people as families grow smaller. This is significant because the market for housing, appliances, and many other things depends more on the number of families than on the

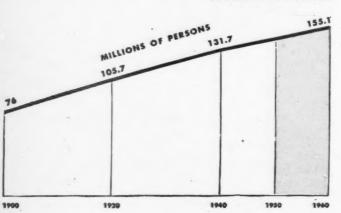
number of people.

2. Our population will be getting older. But it will not be getting less productive because the proportion of the population between the ages of 20 and 60 will be higher than in past decades. Still, the most striking increase will take place in the number of people over 60—from 14 million in 1940 to more than 20 million in 1960. This will bring greater demand for medical services and social security. An important cause of this trend is our success in controlling communicable disease. The following table shows how the death rate from selected causes has changed since 1900.

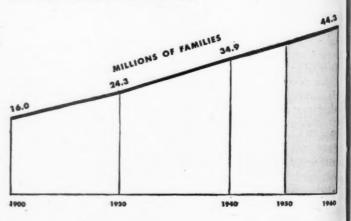
Death Rate Per 100,000 Person

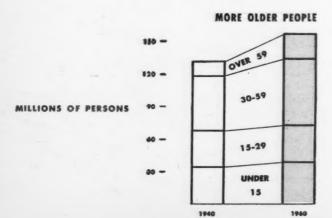
	Death Rate I er	100,000 rersons
	1942	1900
Diseases of heart	295	137
Cancer and other malignant tumor	s 122	64
Influenza	56	202
Tuberculosis	43	194
Diarrhea and enteritis	9	143
Whooping cough	2	12
Diphtheria	1	40
Measles	1	13
Typhoid and paratyphoid fever	0.5	31
Scarlet fever	0.3	10
Other	505.2	873
	1035.0	1719

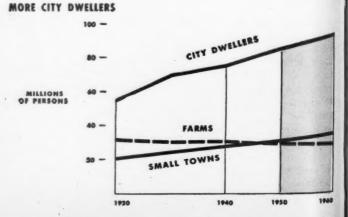
TWICE AS MANY PEOPLE



BUT THREE TIMES AS MANY FAMILIES







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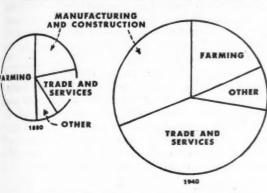
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MILLIONS OF PERSONS IN LABOR FORCE WOMEN

MORE AND MORE WOMEN ARE SEEKING JOBS

FARMING IS GIVING WAY TO OTHER OCCUPATIONS



3. The population will continue to become more urbanized. Small and medium-sized cities will grow faster than the largest cities. The general westward migration which was accelerated by the war will continue.

4. Our people will keep on getting more homoeneous. There has been almost no immigration since 1929, so the number of immigrants who have been in the country for less than 20 years will make up less than one percent of the population in 1950 as against

An even more important factor in making the population all of a kind has been the growth of universal education. The proportion of children 14-17 years old attending high school doubled between 1920 and 1936. The rise of the radio, movies, and national magazines has also levelled us out. These developments not only raise the general educational level of the nation but also tend to standardize the public's tastes and attitudes.

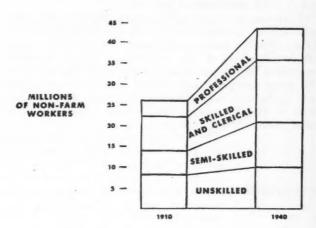
LABOR FORCE

The volume of goods and services produced by 145 million persons in 1950 and 155 million in 1960 will depend on what share of the population is in the labor market and the amount of work those employed actually do. The proportion of the population in the labor force has shown little change in the past few decades. So the 20th Century Fund assumes that the relationship between labor force and population will be about the same in 1950 and 1960 as it was just before the war. On this basis 60 million people will be in the labor market in 1950 and 63.4 million ten years later.

As you can see from the charts, however, there will be several important changes in the composition of the labor force. More women will be working. In 1870 only one out of every eight worked. By 1940 the pro-

ANATOMY OF THE LABOR FORCE

THE LABOR FORCE IS GROWING MORE SKILLED



portion had grown to one out of four, and evidently will go on rising.

However, the increase in the number of women working will just about be offset by earlier retirements and longer schooling. This explain why there is little change in the ratio of labor force t population.

UNEMPLOYMENT

The effectiveness of the labor force depends not only on its size but on how fully it is employed. We have never had full employment in the sense that everyone able and willing to work had a job at the same time. Even in good years unemployment has seldom averaged less than 5% of the working force because workers are always moving from job to job. And in 1932, nearly one-fourth of all workers were unable to find jobs.

For this reason, the 20th Century Fund assumes that, even with good business in the 1950s, unemployment will average 5% of the labor force. This works

out to 3 million unemployed in 1950. In addition, the Fund expects the long down-trend in average weekly hours to continue. A century ago, workers put in a 12 hour day for 6 days a week. By 1940 the average work-week had declined to 44 hours in non-agricultural jobs and 52 hours in agriculture. If this trend continues, the average in non-farm jobs will be down to 38 hours a week in 1960, and farmers will work 48 hours.

Adding all this up, and allowing for vacations, absenteeism, and sickness, the 20th Century Fund estimates that the U.S. will put in 121 billion man-hours of work in 1950 and 118 billion in 1960. This compares with 105 billion in 1940 and with 154 billion at the peak of the war effort. The quantity of goods and services that can be turned out with this amount of labor effort will depend on average output per manhour, or productivity.

PRODUCTIVITY

The key to our future economic welfare is productivity. It is the five-fold increase in output per man-hour that has made it possible for us to work shorter hours and still enjoy a rising standard of living. This increase in productivity has been accomplished not by working harder but by constantly inventing better machinery to supplement human energy with mechanical power.

energy with mechanical power.

Of course, in any specific factory at any given time, productivity depends largely on the willingness and ability of labor and management. But over the years, the actual effort of the individual worker becomes much less important than the effort of the machine. The most energetic and skilled blacksmith of a century ago could not remotely approach the productivity of today's semi-skilled worker operating auto-

matic power-driven equipment.

In 1860, the average worker turned out 33¢ (in 1944 dollars) worth of goods in an hour. By 1940, this had grown to \$1.22. This sensational increase in productivity was due to the increased use of power-driven machines. In 1860, the average worker had the help of only half a horse-power of animal or mineral energy. In 1940, he had the use of 2.7 horse-power. To put it another way, if there

had been no increase in the use of mechanical power since 1850, it would have taken 290 million workers to turn out the amount of goods and services actually produced at the peak of the war effort by only 63

million workers.

EACH PRODUCING

MORE ...

DO MACHINES KILL JOBS

Past history also shows that we need not fear the long run effects of the introduction of labor-saving machines. On the contrary, the only way we can improve the material welfare of everyone is to continue and even step up the rate at which we save

labor by using machines.

Some people, it is true, are thrown out of work and a few of them may not be able to find other jobs easily. But mechanization more than compensates for "technological unemployment" by making it possible to produce more and better things for everyone—things that themselves create jobs. Development of the railroads and the automobile, for example, put a lot of canal boat and livery stable operators out of business. But it cut the cost of transportation and created many times more jobs than it eliminated.

The 20th Century Fund also points out that the most important reason that the technological revolution developed luxuriantly in the U. S. between 1850 and 1940 was that competitive enterprise provided a generally favorable climate. It is true that natural resources were plentiful and that the population was growing rapidly both in numbers and in skill. But what we had to a unique degree here was an atmosphere which favored risk-taking, fostered the vast capital investment necessary to harness and apply mechanical energy, and provided the incentives necessary to put capital and inventiveness to work.

No other economy has equalled ours in the ability to produce more and more with continually diminishing human effort. The test it now faces is whether it can eliminate the ups and downs in production and employment that have gone along with it. But an abundance of evidence indicates that we ran into trouble after 1929 not because we developed too many labor-saving machines but because we didn't adjust our economic mechanism to keep the process going.

The key importance of mechanization is indicated by the fact that the increase in national production since 1860 closely parallels the increase in use of mechanical power. Between 1860 and 1940, both volume of production and use of energy multiplied about

ard of living rising, we must continue to apply more and more power to production.

Chief advantage of mechanical energy is, of course, its low cost. Electric energy is now delivered for as little as a cent a horsepower, while the same amount of human energy costs \$10.

11 times. It is clear that, in order to keep our stand.

And there are other important advantages. Mechanical energy can be delivered in greater concentrations than any other form. It is also more convenient, compact, mobile, and controllable. Consolidated Edison in New York delivers enough electricity in a day to do

the work of 3 million draft horses.

These advantages are now so universally accepted that it's hard to realize how recently we left the horse and buggy era. At the turn of the century, animals and men provided more than half the energy used in production and transportation. It wasn't until World War I that trucks replaced horses in local hauling and tractors began to invade the farms. Here is how the use of mechanical energy has grown since 1850:

	Total Energy Output	Perc	ent Supplie	d by:
	(Billions of Horsepower- Hours)	Mechanical Energy	Humans	Animals
1850	17.6	6	15	79
1860	25.2	7	14	79
1870	27.8	12	15	73
1880	39.9	17	14	69
1890	61.1	28	12	60
1900	82.9	38	10	52
1910	131.4	57	8	35
1920	197.4	73	6	21
1930	238.3	84	5	11
1940	289.4	90	4	6
1950	410.4	94		3
1960	489.8	96	3 2	2

PRODUCTIVITY IN THE FUTURE

Any attempt to predict future developments in productivity is complicated by the fact that the changes do not occur at an even rate. Between 1850 and 1940 the average increase in output per manhour was 18% per decade. But the changes varied all the way from 3% between 1870 and 1880 to 42% for the decade ending in 1940. There is, therefore, no simple way to extend past trends to obtain a fool-proof figure for productivity at a future date.

For purposes of this study, however, the 20th Century Fund assumes that the average rate of increase since 1850 may be projected to estimate output per man-hour in 1950 and 1960. Thus, output per manhour works out to \$1.44 in 1950 and \$1.70 in 1960 as

against \$1.22 in 1940 (all in 1944 dollars).

As the Fund points out, this is a critical assumption, and it is further complicated by the fact that there is a wider possibility of error in this estimate than in most of the others in the study. If, for example, it is assumed that productivity will increase at the pace set from 1920 to 1940 which averaged 36% per decade, then 1960 production would be about double the 1940 level instead of only 157% of it, as the 20th Century Fund estimates.

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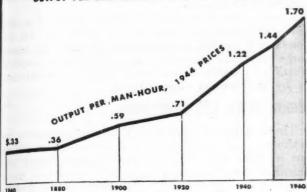
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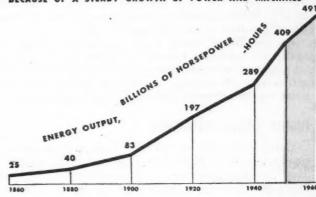
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A CENTURY OF ECONOMIC PROGRESS 1860-1960

OUTPUT PER MAN-HOUR SHOULD BE 5 TIMES AS GREAT



BECAUSE OF A STEADY GROWTH OF POWER AND MACHINES



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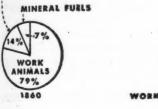
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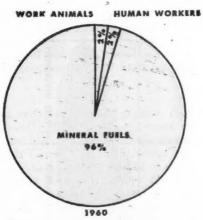
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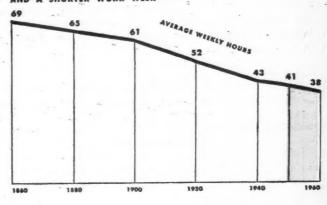
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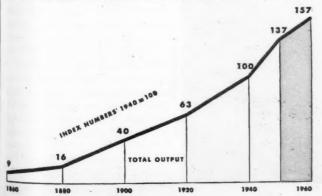
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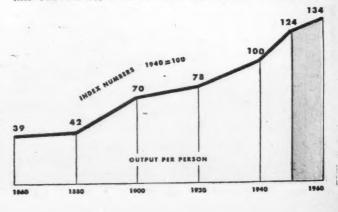
AND A SHORTER WORK WEEK



6 TIMES AS MANY WORKERS CAN PRODUCE 17 TIMES AS MUCH



AND PROVIDE 31/2 TIMES AS MUCH OUTPUT FOR EACH PERSON



TOTAL NATIONAL OUTPUT

The potential volume of goods and services in 1950 and 1960 can be determined by simple arithmetic, using the assumptions outlined on the preceding pages. Of an estimated population of 145 million in 1950, about 60 million persons will be in the labor market and 57 million of them will have jobs if we succeed in keeping business activity at a high level.

This many people would work 121 billion manhours. With output per man-hour estimated at \$1.44 (in 1944 dollars) the total value of goods and services produced, or the gross national product, would come to \$177 billion. Similar calculations yield a gross national product of \$202 billion for 1960.

As the 20th Century Fund emphasizes, these estimates are neither a forecast of actual production nor an appraisal of maximum potential production. They are merely an attempt to show in dollars and cents what can be achieved with high-level employment.

HIGHER LIVING STANDARDS

Compared with any prewar year, a gross national product of \$177 billion in 1950 and \$202 billion in 1960 would represent a handsome gain. It would make possible a substantial rise in living standards.

In 1950 we would produce a fifth more than in 1941.

ENOUGH GOODS

AND SERVICES ...

However, the volume of goods and services turned out in 1950 would be only slightly higher than present production. This is because the number of persons at work today is 2 million above

the estimated normal for 1950, and average weekly hours are higher than they will be then. Almost a

million and a half of the emergency workers drawn into the labor force during the war are still at work and unemployment is lower than the figure assume for 1950.

The estimates of 1950 and 1960 gross national product, as well as the figures for past years used in the chart, are expressed in 1944 prices. This is not a production that the price level will settle down to the 194 level which would involve a drop of 18% in the country of living and 26% in wholesale prices. It is merely device to eliminate price fluctuations so that the figures will show only the actual changes in the physical volume of production.

Gross national product measures the total market value of everything the nation produces. All the goods and services produced are absorbed in one of three ways: by consumer expenditures; by expenditures for investment in capital goods or inventories; or by government expenditures.

HIGHER TAXES, LESS INVESTMENT

The division of total output among consumers, in vestment, and government will be somewhat different in 1950 and 1960 than in the past. About two thirds of total output will go into consumer good and services. This is about the same as the proportion in prewar years.

Government's share will continue to grow, however. It rose from 11% of total output in 1929 to 17% in 1940. At the peak of the war effort, half of all production went to Uncle Sam, Government expenditures have dropped to less than half the war peak and they will continue to decline slowly. But government's share will still run to around 20% in the 1950's. On the other hand, the ratio of investment to total output shows a slight long term decline.

HOW TOTAL OUTPUT IS DISTRIBUTED

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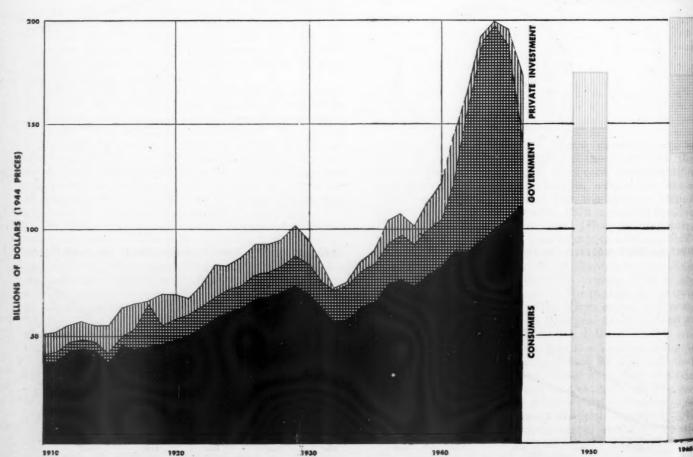
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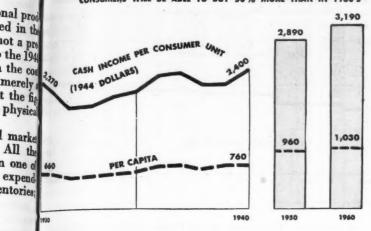
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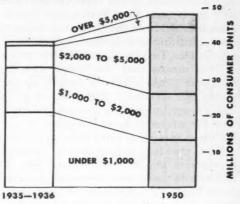


MORE CONSUMER PURCHASING POWER

CONSUMERS WILL BE ABLE TO BUY 50% MORE THAN IN 1930'S



EVERY OTHER FAMILY... INSTEAD OF EVERY SIXTH FAMILY...
WILL HAVE \$2,000 OR MORE TO SPEND.



CONSUMER INCOME

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RIBUTED

U. S. business can look forward to a 1950 consumer market twice as large as in the worst year of the depression, half again as large as in 1929, and one-fifth larger than in 1941. That is the major conclusion of the 20th Century Fund's analysis of consumer purchasing power. Here are the steps by which it arrives at that conclusion:

1. With gross national product at \$177 billion in 1950, past experience indicates that income payments

to individuals would run to \$138 billion.

2. Income tax rates are assumed to equal the 1942 schedules, so individuals would pay \$11 billion in

taxes (as against \$19 billion in 1946).

3. Savings are estimated at \$12 billion, or about 9%

of income after taxes.

4. Subtracting taxes and savings, consumer purchases of goods and services would total \$116 billion.

LOWER SAVINGS

Many experts would criticize the assumption that savings will amount to only 9% of income. Some of them look for a ratio as high as 20% in prosperous postwar years. The 20th Century Fund justifies the use of a low figure on three grounds: (1) people built up reserve of savings during the war; (2) expanding social security will reduce the need to save for old age; and (3) taxes will cut into savings. The Fund's estimate of savings plus taxes in 1950 adds up to a higher percentage of income than in prosperous prewar years.

The standard of living won't rise as rapidly as the total income going to consumers, because the increased income will be split up among more family units. But the average consumer unit (a family or a single person living alone) will be a third better off

in 1960 than in the 1930's.

Shifts in the distribution of income will be even more important, from a marketing standpoint, than the general increase in over-all consumer income. More consumer units will be in the over-\$2000 brackets than ever before and this group will be receiving a much larger share of total consumer in-

Part of the apparent increase in income is cancelled out by higher prices. To show the actual increase in purchasing power, the figures should be adjusted for an estimated one-third increase in the 1950 price level over that of the mid-1930's. This would mean that a \$2,650 income in 1950 would buy no more than a \$2,000 income in 1935-36. Even if this adjustment is made, the resulting figures still show a striking upward shift.

Income Class	Consume in Mil		Cash In in Bill	
	1935-56	1950	1935-36	1950
Total	39.2	47.9	\$85.0	\$135.0
Under \$1000	20.8	13.0	17.0	7.7
\$1000-2000	12.2	12.9	28.1	21.5
\$2000-5000	5.5	18.2	23.8	62.1
Over \$5000	0.7	3.8	16.1	43.7

In addition to dollar income, shown in the above table, consumers also receive "income in kind"—food and fuel produced by farmers for their own use, board and lodging received by domestic servants. Such income will have a value estimated at \$3.3 billion in 1950, most of which will supplement the \$7.7 billion received by those in the "under \$1000" bracket.

The urban market will continue to be far more important than the rural market. Consumer units in cities will receive cash incomes of \$3,445 on the average in 1950, more than twice the farm average of \$1,635 and almost twice the small town average of \$1,880.

THE FARM MARKET

These figures don't provide an accurate measure of the relative importance of the rural and urban markets because rural consumers pay a lot less for food, fuel, shelter and so have more to spend for other things. If there were any way to adjust for these things, the figures would show a smaller spread between the two markets, but the urban market will still be dominant.

All these figures underline a general upgrading in consumer demands which would accompany high-level production and employment. It will have a profound effect on marketing practices. The average person will eat better, dress better, and live in a better house with better equipment. And he will have more money to spend for travel, recreation, and luxuries.

FOR CONSUMERS ..

CONSUMER MARKETS

The improvement in living standards during the 1950 decade will lead to important changes in the way consumers spend their dollars. Even though they will eat better, dress better, and live in better houses, a smaller share of the consumer dollar will be spent on food, clothing and shelter. A growing share will go for appliances furniture, travel, and recreation.

appliances, furniture, travel, and recreation.

This means that the fastest growing markets will be those providing what might be called "optional" goods and services — things which add to comfort and enjoyment but which are not strictly necessary. Markets for necessities, on the other hand, will expand at a slower rate than total consumer expenditures.

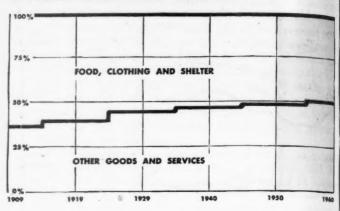
The growing importance of "optional" goods and services is one of the reasons why it's increasingly difficult to keep our economic machine going on an even keel. The purchase of "optional" goods can be postponed with little hardship. So anything that causes people to put off buying a new car, a new house, or a new radio has a far greater effect on production and employment now than it did when the major share of the consumer dollar went for necessities.

Some of the trends in major markets are summarized in the following sections.

FOOD

Although food is by far the largest item in the consumer budget, its relative importance is declining slowly as living standards rise. People eat the same number of pounds of food they ate in 1909 but the food is better from a nutritional standpoint and easier

STANDARD OF LIVING YARDSTICK: MORE OF THE CONSUMER DOLLAR GOES FOR THE COMFORTS OF MODERN LIFE



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to prepare. Thus, the trend favors fruits, vegetables, and dairy products as against meat, potatoes, and bread.

More and more food is being processed in factories rather than in consumer kitchens. Improved methods of manufacture and distribution have transformed the luxury foods of yesterday into the standard foods of today. New kinds of processed foods—canned, frozen, and dehydrated—are appearing constantly.

CLOTHING

Three long term trends will shape the clothing market in the future: (1) the shift from home and custom to factory fabrication is almost complete;

WHERE CONSUMER DOLLARS GO

(Figures in Billions of Dollars)

				(1944 Prices)			
*	1909-	1919	1929	1940	1941	1950	1960
Total Consumer Expenditures	28.8	60.8	80.3	70.6	80.4	116.2	134.2
Food, Liquor, and Tobacco	9.9	22.3	23.7	21.9	25.3	36.2	*41.1
Food	7.4	18.8	19.9	16.4	19.0	27.2	30.8
Liquor and Tobacco	2.5	3.5	3.7	5.5	6.3	9.0	10.3
Clothing and Personal Care	4.4	9.8	12.1	9.8	11.5	16.2	18.7
Housing	6.8	10.1	14.4	12.6	13.3	19.3	21.4
Rent a	5.5	7.9	11.3	9.1	9.7	14.0	15.4
Fuel	1.0	1.5	1.7	1.7	1.8	2.5	2.8
Electricity	0.1	0.3	0.6	0.9	1.0	1.6	1.8
Household Equipment and Operation	2.8	6.2	10.6	8.7	10.3	15.0	17.4
Appliances	0.2	0.4	0.8	1.0	1.3	1.8	2.4
Consumer Transportation	1.6	5.2	8.6	7.3	8.6	12.7	16.4
Autos and Private Planes b	0.6	3.5	6.0	5.7	6.8	9.6	12.7
Local Bus and Street Car	-	_	0.8	0.7	0.8	1.5	1.5
Intercity Bus	-	_	0.1	0.1	0.2	0.2	0.2
Airlines	-	-	c.	c.	c.	0.1	0.5
Railroads	0.4	0.8	0.6	0.3	0.3	0.4	0.3
Medical Care, Insurance, and Death Expenses	1.1	2.8	4.5	4.7	5.2	7.7	8.7
ecreation	0.9	2.1	3.8	3.3	3.7	5.7	6.9
Radio and Television Sets	0.2	0.7	1.0	0.6	0.8	1.1	1.3
Private Education, Religion, and Welfare	1.2	2.2	2.7	2.3	2.4	3.4	3.7

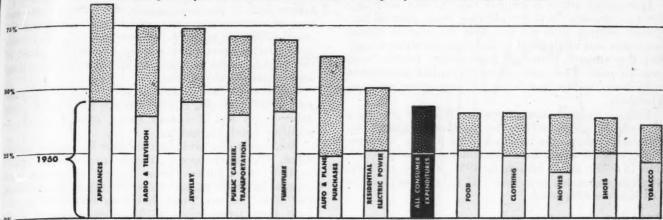
a. Includes Estimated Rent for Owner-Occupied Homes.

b. Includes Original Cost and Operating Expenses.

c. Less than \$50 Million.

CONSUMER MARKETS IN 1950 AND 1960: Percent Increase in Sales Over 1940

Bottom Segment Equals Percent Increase 1940-1950; Total Height Equals Percent Increase 1940-1960.



(2) synthetics, chiefly rayon and nylon so far, are replacing cotton, wool, and silk at an accelerating pace; (3) there's greater standardization of styles and a trend to lighter and simpler clothing.

In 1909 consumers spent 14% of their income for clothing but by 1940 the ratio had reclined to 12%. However, this long run decline may be halted or reversed. The migration from farms to cities, the upgrading of incomes, and the growing demand for sports clothing will increase clothing expenditures.

HOUSING

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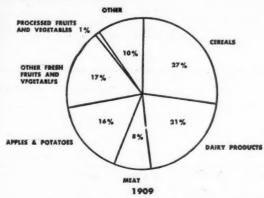
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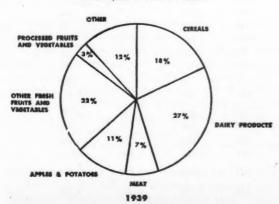
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The decline in the relative importance of housing expenditures — from 24% of consumer dollars in 1909 to less than 18% in 1940 — is expected to continue. The reason is that people feel they get more value

OUR CHANGING DIET: MORE MILK, FRUITS AND VEGETABLES
LESS MEAT, POTATOES AND BREAD





1880 POUNDS OF FOOD PER PERSON

1882 POUNDS OF FOOD PER PERSON

for their dollars in other things than housing. Nevertheless, the housing market should be much larger in the 1950's than in the 1930's because much of our housing needs to be repaired or replaced.

A Census survey in 1940 showed that 16 million of the nation's 37 million dwelling units needed to be replaced or needed major repairs. The 20th Century Fund estimates that the provision of adequate housing for everyone by 1960 would involve building 20 million new units and rehabilitating 5.4 million at a total cost of \$115 billion (1944 prices). The Fund also estimates that we will fall 15% short of this goal even with continued high-level employment.

HOUSEHOLD EQUIPMENT

More and more of the consumer dollar has gone for household equipment in the past four decades, largely because of the development of labor-saving appliances. The outlook is for a continuation of this trend. New appliances are being developed; and the large number of new houses slated to be built in the next few years, the wartime and postwar boom in the number of families, and the migration to the cities should add to appliance demand. The same factors should brighten the outlook for furniture, rugs, and other household items.

Some appliance markets may be saturated by the 1950's, however. A few years of high production would fill our homes with refrigerators, for example. However, replacement demand would run to 2.7 million units in 1960 and there would be a demand for 1.3 million refrigerators to equip new houses, so the market would still be bigger than in 1941 when 3.6 million were sold. However, new products must be developed if the industry is to keep up the pace it has set in the past.

TRAVEL

In 1916 the average person traveled 400 miles. By 1940 the average had grown to 2,400 miles, chiefly because of the rise of the automobile. The 20th Century Fund expects this growth to continue because as their incomes rise people spend more money traveling.

A good share of the increased spending will go to purchases of cars and planes. The Fund estimates that there will be 36 million cars on the road and 100,000 private planes in the air in 1950. The auto industry would be able to sell 5 million new cars a year after 1950—4 million for replacement and a million for population growth.

CAPITAL INVESTMENT

Investment plays a crucial role in our economy for two reasons. It is by plowing back part of our annual output that we are able to provide better machines and equipment to keep productivity rising. But the amount ploughed back varies widely from year to year. This unevenness of capital investment contributes to the instability of production and employment.

Because capital investment involves the purchase of durable goods, it can be postponed almost indefinitely when the outlook for profits darkens. Thus, capital investment plummeted from \$18 billion in 1929 to \$5 billion in 1933, a drop of 72%, whereas consumer spending fell only about half as

fast in the same period.

MORE FOR EQUIPMENT

There has been an important shift in the relationship between construction and equipment, the two major types of investment. Before World War I, construction made up around three-fourths of total investment but the ratio declined to less than half in 1935-39. Part of the decline is, of course, explained by the fact that the depression left us with ample plant capacity but provided an incentive to buy more efficient machines to cut costs. Nevertheless, there is a well-defined trend towards allocating an increasing proportion of investment to equipment rather than to plant construction.

A little less than two-thirds of total investment

goes into industrial plants and equipment. Housing and other consumer construction (hospitals, schools, churches) averaged 27% of total investment during the interwar period. Housing fell from a peak of \$6 billion in 1926 to \$4.7 billion in 1929 and \$600 million in 1933; and it had recovered only half the 1926 volume by 1940.

While other types of investment follow the ups and downs in general business, investment in housing construction follows a cycle of its own. This housing cycle is determined by factors such as the vacancy rate, the level of rents, and that of construction costs, which may not follow the trend of general business. When a drop in general business activity takes place during a declining phase of the housing cycle, as it did in 1929, the result is a deep and prolonged depression.

Government investment, of which the largest com-

Government investment, of which the largest component is highways, has been much more stable than other types but it doesn't swing enough weight to 10% -

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stabilize total investment.

Because of the wide fluctuations in capital investment, it's much more difficult to estimate future capital expenditures than future consumer purchases. In order to make a relatively stable forecast, the 20th Century Fund bases its estimates on the long term trend since 1879, which shows a slight decline in the share of total output going to capital investment. Thus, investment under conditions of stable prosperity in the 1950 decade is estimated at 16% of total output as compared with a ratio of more than 18% in the late 1920's. On this basis, estimated capital expenditures work out to \$28 billion for 1950 and \$33 billion in 1960. Our ability to maintain high employment and rising living standards will depend in large measure on our ability to invest that much profitably in new machinery and buildings.

CAPITAL NEEDS

Analysis of our capital needs lends little support to the idea prevalent during the 1930's that we had reached economic maturity so that there was no way to invest as much as we had in earlier decades. No one has ever made an estimate of how much it would cost to modernize our industrial plant, which is valued at around \$200 billion at prewar prices. If as much as a third of it needs to be replaced or rehabilitated, around \$100 billion (current prices) of additional investment will be required.

In addition, huge amounts of money need to be invested in housing and public works to raise the serv-

WHERE INVESTMENT DOLLARS GO

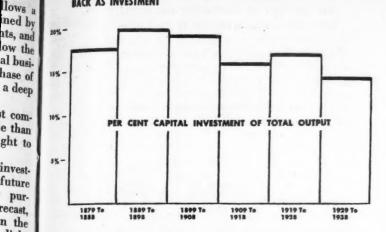
(Figures in Billions of Dollars)

CAPITAL

INVESTMENT ...

		Annual Avera	ges)				
	1920-	1925-	1930-	1935-	1940-	(1944 Prices)	
	1924	1929	1934	1939	1944	1950	1960
Total Capital Investment	\$12,428	\$17,186	\$8,215	\$10,445	\$12.340	\$27,700	\$33,000
All Industries	7,570	10,112	5,272	6,889	8,089	17,800	21,125
Manufacturing	1,996	2,362	1,074	1,610	3,731	4,200	5,025
Food	261	357	194	244		228	273
Textiles	227	212	92	117		175	210
Steel	138	188	110	192		853	1,021
Autos	105	150	78	146		369	441
Chemicals & Petroleum	70	95	68	142		928	1,111
Machinery	_	_	-	28		180	216
Other	510	625	213	409		1,462	1,750
Transportation	1,797	2,303	1,277	1,822	805	4,300	5,100
Commercial	1,196	1,940	777	719	833	1,950	2,300
Utility	693	. 999	483	422	780	1,500	1,625
Other	1,888	2,508	1,661	2,316	1,940	3,950	4,700
Consumer Construction	3,806	5,557	1,547	2,256	2,912	7,200	8,255
Government Construction	1,052	1,517	1,396	1,299	1,338	2,700	3,620

OVER THE YEARS ABOUT 1/5 OF TOTAL OUTPUT IS PLOWED BACK AS INVESTMENT



ices provided merely to adequate levels. The 20th Century Fund estimates that the cost of a 15 year program to modernize our city streets and rural highways would run to \$40 billion. To bring the nation's housing up to minimum standards of health and decency by 1960 would cost \$115 billion. To conserve our natural resources and develop our water power would cost \$27 billion over a 15 year

There seems to be little question that needs exist for all the capital investment we can make for a long time to come. The behavior of investment in the past strongly suggests that the problem is not one of lack of needs but one of finding ways to add to our capital in an orderly fashion. Capital investment has followed the boom and bust route in the past; what is wanted is a high but steady rate of investment.

WARTIME INVESTMENT DEFICIT

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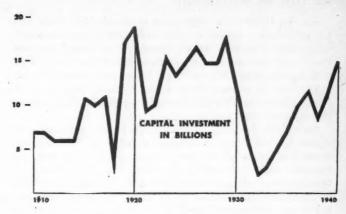
Demand for capital goods is stronger right now than ever before, largely because of the backed-up needs arising out of the war. Here is how wartime expenditures for capital goods which can be used in peacetime production compared with expenditures in the last 5 years of both the 1920's and 1930's: (Figures in billions of dollars)

	1925-1929	1935-1939*	1940-1944
Total Capital investment	\$86	\$65	\$49
Industrial	51	43	32
Manufacturing	12	10	14
Metals, chemicals, machin	nery,		
petroleum	6	6	11
All Other	6	4	3
Commercial	10	5	3
Railroads	5	- 3	3
Electric power	5	3	3
Consumer Construction	28	° 14	12
Public Works	7	8	5
* Adjusted to Wartime Prices			

Wartime restrictions held investment in all civilian lines far below what would be spent in prosperous peacetime years. Thus, there was a backlog of investment needs at the end of the war which ran to more than \$30 billion, if the 1925-1929 demand can be taken as typical. Whatever the precise size of the backlog, it is clearly great enough, when added to the normal yearly demand for new investment, to keep the heavy goods boom going for some time to come. The test of our ability to stabilize capital investment will come later.

There is also a huge foreign demand for American capital. How far we will go toward meeting this depends largely on whether international political and

BUT THE AMOUNT PLOUGHED BACK VARIES GREATLY FROM GOOD YEARS TO BAD, ACCENTUATING THE SWINGS OF THE BUSINESS CYCLE



economic conditions are stable enough to make private foreign investment a good risk.

If we invest abroad in the same proportion we did in the late-1920's, our foreign investments will total \$1.6 billion during the year 1950 and \$1.5 billion in the year 1960. This will mean a net increase in our foreign holdings of \$15 billion during the 1950's, raising the total of such holdings to about \$25 billion, as against a total of \$10.6 billion in 1940.

To make that much foreign investment pay out, an expanding volume of world trade would be required. Foreign nations would have to get enough dollars not only to pay for goods they bought from us but also to pay interest and dividends on U.S. investments. If our overseas investments increase to \$25 billion by 1960, annual interest and dividends owed us will run to almost \$13/4 billion.

To pay us that much, foreign nations would have to sell much more in the U.S. than ever before. The 20th Century Fund calculates that imports of \$7.3 billion in 1950 and \$8.1 billion in 1960 would provide other countries with the dollars they need. Imports ran to \$2.5 billion in 1940 so we would have to buy 3 times as much abroad to keep expanding our foreign investments.

With good business, U. S. demand for imported goods should be well above prewar. Rising living standards will widen the market for such consumer items as British tweeds and French perfumes. Moreover, we will need to import more raw materials than ever before because we used up our natural resources at a prodigious pace during the war.

NEW INDUSTRIES

The new methods, materials, and products developed during the war may well have a more profound and lasting effect on future capital requirements than the backed-up demands accumulated in wartime. Here are some of the wartime developments which may have important peacetime applications: new chemical processes and products including synthetic rubber, plastics, synthetic fibers and fabrics; new food products and new methods of food processing; new uses for glass, plywood, and the light metals; tremendous advances in aviation; and new applications of atomic energy and fissionable products in power production and medicine.

Large capital expenditures will be required to push these developments further and adapt them to civilian use. New businesses and perhaps entire new industries will grow up, adding to the demand for capital goods for many years.

THE COST OF GOVERNMENT

To the traditional certainty of death and taxes can be added the certainty that the cost of government will take a much larger share of national income than ever before in peacetime. After the Civil War and again after World War I, federal expenditures moved up to a level four times prewar. And it is already clear that World War II is going to have about the same effect.

In 1940, federal, state, and local governments spent \$19 billion, of which a total of \$2.2 billion went for national defense, veterans, and interest on the war debt. By 1950, the 20th Century Fund estimates that all governmental units in the U.S. will be spending more than \$45 billion. Federal expenditures are estimated at \$27.6 billion in that year as against \$9 billion in 1940.

Part of the increase is explained by higher postwar prices. Adjusting for price changes would reduce the 1950 figure from \$45 billion to \$33.5 billion. This is still 80% above the 1940 level. Increased expenditures for public works, social insurance, and schools explain another small part of the rise.

But costs arising out of the war are by far the most important factor. Military and veterans' expenditures and interest on the war-swollen national debt will add up to over \$17 billion in 1950. This is only 10% less than total government expenditures in 1940.

The only major category of government expense which would be lower in 1950 is welfare. With highlevel employment and more social insurance, relief and other welfare costs should run to \$2.5 billion in 1950 as against \$3 billion in 1941.

The following paragraphs describe important trends in the major items of government expense.

MILITARY

The 20th Century Fund assumes that we will maintain an armed strength of 2 million men (including trainees) and that it will cost \$3,300 to equip and maintain each man, so total military expenditures will run to \$6.6 billion. But even if we decide to maintain

a smaller armed strength, the total cost might easily be at least \$6.6 billion because the present per serviceman cost of over \$6,000 a year may

not decline.

AND

GOVERNMENT ...

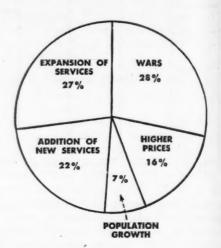
VETERANS

It will cost at least \$2.9 billion to take care of veterans in 1950 even if benefits are not increased. That's 5 times the 1941 cost. Pensions for World War I veterans rose steadily

from \$116 million in 1924 to over \$300 million in 1945. That rise will continue for another 20 years. By far the largest expense will be for World War II pensions which are already costing \$900 million. Disability and death benefits will cost about \$1% billion in 1950; hospitalization will add another \$250 million; and insurance \$150 million.

SOCIAL SECURITY

Future expenditures for social security will depend on whether steps are taken to extend coverage and liberalize benefits. Over 60 million people are now covered so the cost is certain to increase rapidly as more of them begin to draw payments. With highWHY THE COST OF GOVERNMENT HAS INCREASED. The \$25.6 billion increase in cost from 1913 to 1941 was due to:



level employment in 1950, estimated old age and unemployment benefits under the present system would run to over \$5 billion. Expansion of benefits, as recommended by the Social Security Board, would raise the cost to over \$9 billion.

PUBLIC WORKS

Even an economy-minded Congress is almost certain to go along with expenditures for highways, airports, waterways, flood control and conservation. Thus, an increase in expenditures for transportation and natural resources from less than \$2.5 billion to over \$5 billion in 1950 seems probable.

SCHOOLS

Education ranks third among all government expenditures. In 1941 we spent almost \$2.5 billion-10% of all government dollars—on schools. Teachers' salaries account for almost three-quarters of the total cost so the trend towards higher salaries will boost the nation's bill for education.

WHERE TAX DOLLARS GO

(Figures in Billions of Dollars)

	1913	1932	1941	(1944 Prices)	
				1950	1960
All Government			1		
Expenditures	2.5	12.4	23.1	45.5	50.7
Federal	0.7	4.3	12.9	27.6	28.6
State	0.2	1.8	3.6	7.0	9.3
Local	1.6	6.3	6.6	10.9	12.8
Military	0.27	0.7	6.1	5.6	6.
Veterans	0.18	0.8	0.6	2.9	3.
Interest	0.15	1.3	1.7	7.9	8.
Social Insurance	_	0.2	1.9	7.7	8.7
Welfare & Health	0.31	1.5	4.1	4.0	4.
Education	0.65	2.5	2.7	3.7	4.
Public Works	. a.	a.	a.	5.6	7.
Transportation	0.40	1.9	2.0	1.8	2.
Natural Resources	0.03	0.6	1.4	1.2	1.
Police & Fire	0.19	0.7	0.7	1.0	1.
Other	0.40	2.4	2.0	3.0	3.

a. Included in other groups.

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NATURAL RESOURCES

The war left the U. S. with a depleted supply of most natural resources, and with critical shortages of some of the most essential minerals. Nevertheless, lack of natural resources should not be a limiting factor on our productive capacity. With relatively free access to world markets, we should be able to get all the raw materials we need. And, even if we were denied access to world markets, we could use our low-grade reserves and develop substitutes without causing a prohibitive reduction in our living standards, though everyone would feel the effects in one way or another.

The U. S. economy consumes about a billion and a half tons of raw materials each year, or about 11.5 tons per person. Of this 3.5 tons are coal, 1.5 tons are petroleum, and iron and copper ore each contribute about a half a ton. In 1939 the value of unrefined minerals output was \$4.2 billion and 2% of all workers were engaged in mining or lumbering.

FUTURE REQUIREMENTS

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AILABLE . . .

The level of industrial production projected by the 20th Century Fund would raise minerals requirements a third above 1940 by the year 1950 and 50% above 1940 a decade later. Here is how natural resources requirements in the 1950 decade would compare with 1940 and the wartime peak: (Index numbers, 1940 equals 100)

Wartime Peak	1950	1960
138	133	151
157	117	126
130	141	164
141	128	142
126	93	76
159	173	224
120	94	75
	Peak 138 157 130 141 126 159	Peak 1950 138 133 157 117 130 141 141 128 126 93 159 173

The capacity of our supplies of natural resources to support future levels of output cannot be determined with any great accuracy. It will depend on

the size of our reserves and on our ability to use supplies more economically and develop substitutes.

Because there is no way to measure these factors with any degree of precision, all estimates of the number of year's supply are subject to wide errors. However, such estimates are useful in directing attention at those resources where every effort should be exerted to develop new

supplies, substitutes, and more economical methods of use.

BIGGEST PROBLEMS: LEAD AND ZINC

Commercial grades of zinc, lead, and bauxite will be exhausted before 1960 even if the rate of use is cut to half the wartime rate. Supplies of petroleum and natural gas—which furnish 40% of our energy—will last longer than 20 years but their partial depletion will raise many technical and economic problems long before that time. Possible exhaustion of high-grade deposits of such minerals as iron and copper in the foreseeable future will stimulate development of processes to use low-grade deposits.

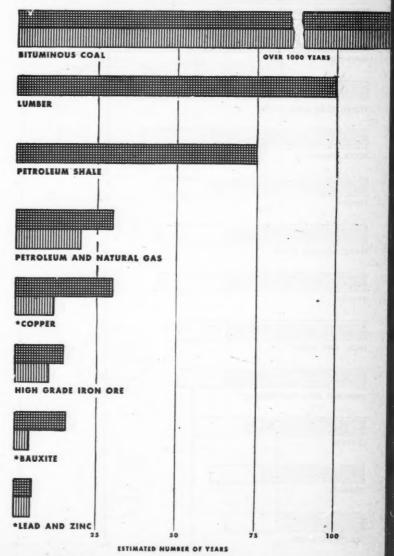
We have been discovering more and more ways to stretch our supplies of natural resources, however. In the case of tin, the electroplating process saves 50% of the tin used in tinplate production. The electric power industry uses less than 40% as much coal per kwh now as in 1920. The development of new materials and new ways of using old materials also expands our resource capacity.

Our bituminous coal reserves are adequate for over a thousand years even at the wartime rate of use, though production costs might rise substantially as inferior coal beds were used. After that, there are huge deposits of sub-bituminous coal and lignite which could carry us along for another thousand years. In comparison, maximum petroleum reserves are minute, adequate only for about 30 years consumption at the current rate. That is why the experts are trying to find ways to produce oil from coal cheaply enough to be commercially feasible.

Even though we have been using up lumber faster than it grows, there is little doubt that enough will be available in the future to meet at least minimum needs. Annual timber growth runs to about 32 billion board feet. But we cut over 40 billion board feet a year before the war and lost another 6 billion through fire, insects, and disease. An adequate conservation program could increase annual growth enough to offset this depletion.

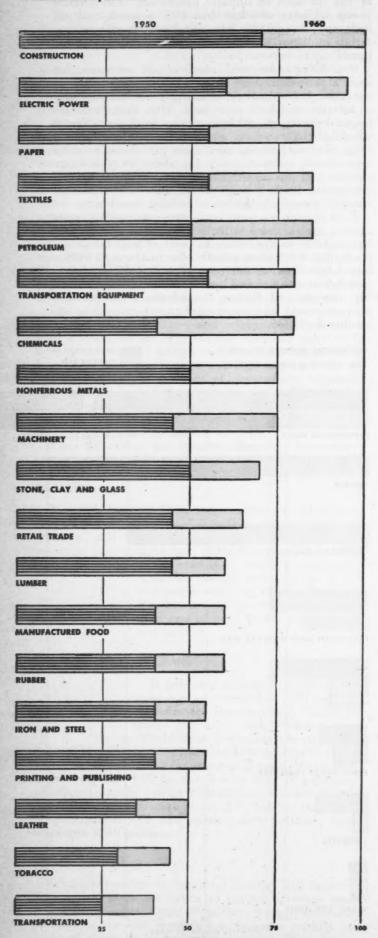
OUR NATURAL RESOURCE RESERVES
Years required to exhaust supplies

1940 RATE OF USE
WARTIME RATE



*COMMERCIAL GRADES

PRODUCTION PROSPECTS: Estimated Percentage Increase in Industrial Activity Over 1940



INDUSTRIAL CAPACITY

At the end of World War II U. S. industry found itself with surplus capacity in some lines and serious deficiencies in others. There was more than enough aircraft, machine tool, and synthetic rubber capacity but not nearly enough sheet steel, copper, or electrical machinery capacity to meet pent-up demands.

War experience showed, however, that industrial capacity can be expanded enormously in a few years, given the need and the funds. Thus lack of industrial capacity should not prove a bottleneck to meeting the demands of consumers in the 1950 decade.

A rough estimate places our total investment in industrial facilities (manufacturing, mining, transportation, and distribution) at \$200 billion. Just how much capacity industry as a whole, or any given industry, has is impossible to measure.

Capacity is a most elusive concept. In a technical sense, the capacity of an industry is the combined production of all its plants working 24 hours a day, 365 days a year, less an allowance for repairs, breakdowns, and other technical factors. Actual capacity is far less, however. Some facilities are obsolete or high-cost. Supplies of raw materials and components may be insufficient to keep assembly plants running full-steam. Moreover, demand for many product isn't great enough to support round-the-clock production.

PLENTY OF CAPACITY

During the past quarter century, however, experience shows that we have had more than enough overall capacity, and more than enough capacity in almost every industry, to meet all demands. An extensive study showed that even in 1929 only the steel and machine tool industries were definitely operating at capacity.

The growth of productivity as old machines are replaced with new and more efficient ones and as new techniques are developed is one of the main reasons why industrial capacity more than keeps pace with markets. The depression of the 1930's led to a net retirement of about 5% of total manufacturing facilities but manufacturing plants in 1939 could have turned out a quarter more than in 1929 because productivity was a third higher.

Whenever an industry's output begins to approach technical capacity, it becomes profitable to purchase new and more efficient equipment to replace or supplement existing machines so that a certain amount of excess capacity seems to be inevitable in a free

enterprise system.

Estimates of the level of industrial production in different lines under conditions of high-level employment during the 1950 decade are shown in the chart. They assume that past trends will continue so that they give only a rough idea of what would happen to output in each industry. Unpredictable shifts of consumer demand or new product developments might cause a big change in the pattern of industrial production. Such estimates are, nevertheless, useful in that they provide a clue to lines where the largest increases may take place.

None of the projected increases are so large as to tax our ability to provide enough capacity. This is not to say that there will be no bottlenecks because of lack of capacity for certain components, for instance. However, we should be able to make good in short order any deficiencies of that sort that may develop.

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DEMANDS VERSUS NEEDS

Despite the substantial increase in living standards which would be possible with high-level production and employment in the 1950 decade, many U. S. consumers will be unable to buy enough of life's necessities to maintain themselves at a health and decency level. Almost 30% of all families would receive less than \$1,000 a year cash income and one-third of this group would receive less than \$500. The 20th Century Fund asked a series of experts

The 20th Century Fund asked a series of experts to estimate the quantities of food, clothing, housing, medical care, and other things needed to provide a standard of living at a minimum health and decency level. The experts also figured out how much it would cost to bring everyone expected to be below that standard in 1950 and 1960 up to the calculated level. In other words, the estimates show the cost of establishing a "floor" for consumption without disturbing the spending patterns of those who received more than enough income to satisfy the calculated minimum needs.

ESTIMATES OF NEEDS

Any estimate of "needs" must rest upon someone's opinion as to what constitutes "health and decency" in this day and age. In the case of food, the nutritional requirements of a minimum health and decency standard can be determined accurately. In other fields, such as housing and education, even the experts would disagree over what constitutes a minimum standard.

However, what is important is not the precise size of the estimates but their general magnitudes. The conclusion that we would have to spend about 50% more on medical care than we are likely to in 1950 is important even if the experts' appraisals of the deficit range from as high as 60% to as low as 40%.

To fill total needs calculated in this manner would require production of \$200 billion of goods and services in 1950 or 13% more than the \$177 billion which would be turned out with high-level produc-

tion and employment. In 1960, estimated production would fall short of needs by 8%. Food accounts for the biggest share of the deficit but needs outrun demand by important margins in housing, medical care, education, and social security.

To provide nutritionally adequate moderate-cost meals for those unable to afford them would add \$5.5 billion to the \$27.2 billion that would actually be spent on

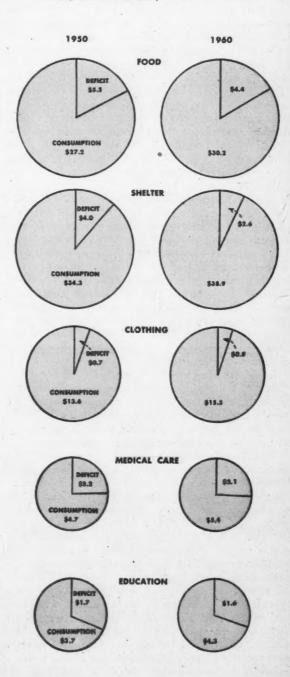
food in 1950. This assumes no change in diets of those with adequate incomes despite the fact that many people in those groups do not eat what they should. If we all ate what we needed, we would consume twice as many fresh vegetables as in 1940, half again as much milk, more fruits and tomatoes; and we would eat smaller quantities of sugar, sirups, fats, and oils. This better diet would cost us less than we will actually spend for food in 1950.

So large a portion of our existing housing is unsatisfactory by any reasonable standards that it would take 10-15 years to provide everyone with adequate housing. One of the reasons why we don't have adequate housing is that many consumers cannot afford to pay enough rent to finance it. Estimated expenditures in 1950 for rent (including the estimated rental

value of owner-occupied homes) would run to \$14 billion as against an estimated need of \$16.4 billion.

Vast advances in medicine have gone far toward eliminating many diseases and have brought about a steady improvement in the standard of health. However, large numbers of people in the lower income groups cannot afford adequate medical care. Moreover, to supply good medical care for everyone under the traditional fee-for-service basis would cost several times more than consumers have ever spent for medical services even in prosperous years. Development of an effective form of group medicine, however, would make it possible to provide adequate care at a great saving over present costs, according to the 20th Century Fund.

NOW CONSUMPTION WOULD COMPARE WITH TOTAL NEEDS
(Figures in billions of dollars)



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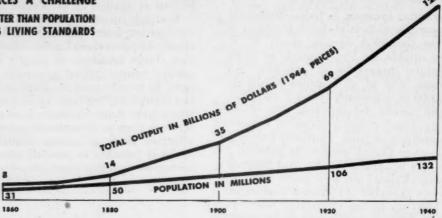
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PRODUCTION HAS GROWN FASTER THAN POPULATION GIVING PROMISE OF RISING LIVING STANDARDS



The major conclusion of the 20th Century Fund's survey of America's needs and resources is that we have reached a point where we can provide everyone with a decent living and most people with a living which, by any standards other than our own, is positively luxurious. With high-level employment, it would take only a 13% increase in total output in 1950, and an 8% increase in 1960, to lift everyone to a minimum health and decency standard of living.

We have more than enough industrial and agricultural capacity to support that much of an increase in total production. Lack of natural resources should not be a bottleneck, for with world trade on any sort of a reasonable basis we will be able to get all the raw materials we need.

The only limiting factor is the capacity of our labor force to produce. The 20th Century Fund assumes that productivity will advance at the average rate actually achieved during the past 9 decades (18%). But there is no technical reason why we cannot achieve an increase of more than 30%. That would make possible enough production to meet our minimum needs.

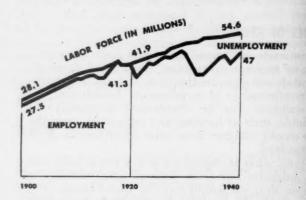
The U.S. economy has exhibited two dominant characteristics in the past century. Our productive capacity has expanded at a rate never approached elsewhere. But our economy has also been highly unstable. Our problem is to make the most of our unparalleled technological and productive know-how while minimizing the swings of the business cycle.

If we can meet that challenge, we can eliminate the specter of want and move on toward constantly rising living standards for everyone. Never before in history has a nation been so close to abolishing poverty and meeting the material demands of its citizens.

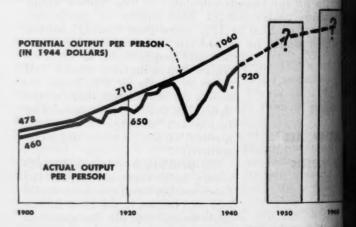
This is not to say that solving the problem of maintaining stable and expanding production would solve all our economic, social, and political problems. Nor is it to say that a solution of the problem of keeping our economic machine running on an even keel is at hand.

In the first place, the U. S. would not be a utopia even if we achieved the kind of high employment and production the 20th Century Fund is talking about. Many perplexing problems of how to best distribute our production would remain. Then there are a host of social and political problems which would still tax our efforts and ingenuity. Finally, there is the allimportant question of how to maintain world peace.

Most people would agree that the problem of maintaining high employment and rising living standards is still far from solution. Our ability to mobilize and direct our economic resources so as to keep our BUT THE GROWTH HAS FOLLOWED THE BOOM AND BUST ROUTE INVOLVING LONG PERIODS OF MASS UNEMPLOYMENT



CAN THE ECONOMY PROVIDE STEADY EMPLOYMENT AND RISING LIVING STANDARDS?



economy running on an even keel has lagged behind our ability to solve technical production problems. Each businessman, each worker, and each consumer must somehow learn to act differently in many ways than he has in the past if we are to solve our number one economic problem.

Just what changes in our economic life will be necessary no one knows. On our ability to find out these things and put them into practice in the next few years depends our success in meeting the challenge which the 20th Century Fund's study underlines. That challenge is that we have within our grasp the ability to eliminate actual want from the U. S. and to provide more and more things for better living for everyone.





BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Primary Feed To Roof Substation

Installation of roof substations has become an accepted practice in a number of industrial plants—specifically the automotive industry where floor space must be clear for assembly lines and production machinery. Although this permits installation of all secondary conduit in trusses and ceiling areas, it requires primary risers which might be located in the plant working area. Precaution must be taken to adequately protect these conduits from mechanical injury and possible contact with working personnel.

Such consideration was taken by Albert Kahn Associated Architects and Engineers, Inc., Detroit, in their design of the electrical distribution

Second floor

See plan below second floor

See plan below second floor

A"

Provide suitable cable supports in box to hold vertical weight of cable supports in box to hold vertical weight of cable

FIG. 1—Primary feeders to roof substations are protected by concrete envelopes and steel jackets where subject to mechanical injury or contact with personnel at new Chevrolet Flint Assembly Plant. Pull and cable support boxes are installed at truss and roof height.

Section X-X

system for the new Chevrolet Flint Assembly plant of the General Motors Corporation. As installed by the John Miller Electric Company, Detroit electrical contractors on the job, primary feeders enter the long assembly plant underground, go up through conduit

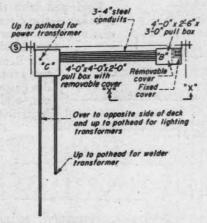


FIG. 2—Conduits extend across ceiling under transformer deck to locations directly under transformer primary potheads. Separate conduits feed power, welding and lighting transformer banks.

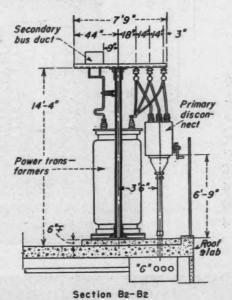


FIG. 3—Typical section of a roof substation transformer bank showing primary feeder termination in pothead disconnect and secondary bus duct which extends through wall of adjacent switchboard room.

risers hugging columns nearest the roof substation location (Fig. 1), are run exposed under the roof slab which forms the transformer deck (Fig. 2) and go up through the slab to potheads at transformer locations (Fig. 3).

A sufficient number of pull boxes were installed at safe locations to facilitate cable pulling and installation of adequate cable supports. In general, these were mounted direct to the roof steel or truss chords—beyond reach of any personnel (See "A" and "B", Fig. 1). Removable covers provided ample access to the boxes.

When primary conduits might be subject to mechanical injury or contact with personnel, they were encased in a concrete envelope for a distance six feet from the floor level. As an added precaution, a 4-inch steel plate enclosure protects the concrete at those points vulnerable to damage by plant truck traffic.

Versatile Infra-Red Drying Installation

-INDUSTRIAL

Infra-red ray drying is not new, but a recent installation at the East Springfield works of Westinghouse has some unusual features that make it more versatile than the usual set-up.

It is unnecessary to revolve the work passing through the drying area because the lamps are so positioned that there are no blind spots, as usually is the case when bulbs larger than the 250-watt lamp are used in conjunction with reflectors. There is a total of 450 250-watt lamps having a combined wattage of 112.5 kw. in the installation

There are ten panels of 45 lamps; these are divided 15 to a row, with a switch for eight bulbs and another for seven. The banks are connected vertically. Thus, when small work is being dried and all the bulbs are not needed, some can be cut out to reduce the cost of operation. Parts dried in the oven range from a fabricated case

suged * FIT THE JOB!



from standard units and enclosed in attractive, easy-toall steel cabinets, (1) Thermag Automatic Circuit Breaker selboards can be made to fit any job requiring panelboards.

Breaker — the circuit breaker with a brain, which distinguishes between momentary and sustained overloads — (6) Thermag Automatic Circuit Breaker Panelboards provide positive protection against short circuits and dangerous overloads, eliminating burned out equipment and other costly and irritating service interruptions.

For your next paralboard, specify
Thermag Circuit Breaker type—
today's answer to tomorrow's service problem.

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for SCHOOLS

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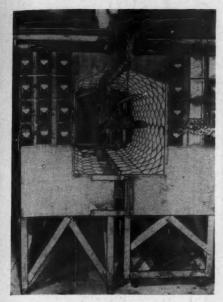
*

1 Thermag Automatic Circuit Breaker Panelboards are as able in standard and narrow column types, dust-tight and vapor-proof construction. Capacities 15 to 50 amps, 120 volt AC only - single or double pole, 4 to 42 branches with 115-230 volt, 3 wire or 120-208 volt, 4 wire solid neutral mains.

MAKERS OF ... BUSDUCT PANELBOARDS SWITCHBOARDS

ank Adam ELECTRIC COMPANY ST. LOUIS, MISSOURI

SERVICE EQUIPMENT SAFETY SWITCHES LOAD CENTERS ELECTRIC QUIKHETER



Proper positioning of the 450 infrared lamps in this drying oven in the East Springfield works, Westinghouse Electric Corporation, prevents any blind spots, making it unnecessary to rotate the work passing through.

weighing 65 pounds to all types of small miscellaneous formed pieces.

The frame is made in two parts, one of which is equipped with castors; it can be unhooked and rolled back to allow lamp replacements or repairs to be made. This also allows the distance from the lamps to the work to be adjusted with ease.

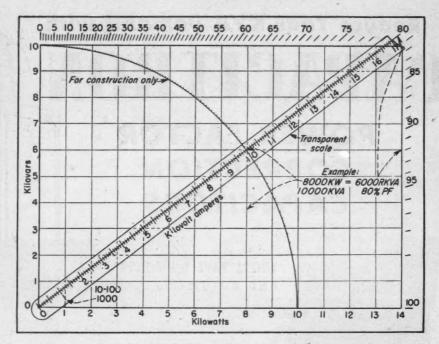
Power Factor Calculator

By EMMETT J. KEOUGH, lowa Electric Light & Power Co.

_INDUSTRIAL

If you are one of the many electricians occasionally required to solve problems relating to kw., kva., rkva. and power factor, you need not brush up on trigonometry or have reference to tables of sines and cosines to give the answers. Take a little time out and construct a calculator. It will give you a better understanding of the relation of these values and will solve the problems with speed and accuracy.

Select graph paper (squared) that is accurately divided with the same scale in both directions. Set your compass equal to 100 units and draw an arc pivoted from the lower left hand corner. This arc includes an angle of 90 degrees. Now with a well-sharpened pencil, mark the intersecting points of this arc with the vertical divisions;



these points are each equal to 1 percent power factor. Now, with a straightedge, project lines to the border from the pivot point in the lower left hand corner through each of the points on the arc and mark your power factor scale. Every fifth division should be inked in heavy (on the border only).

Now make the movable scale (hypotenuse of your problem) out of transparent material with divisions to equal those of the other two scales. This scale will have to be longer than the other two scales. Lay the transparent material on one of the scales and with a good sharp scribe mark the divisions on the top side, making every fifth division with a long line. You can now take black drawing ink and with a fine pen feed ink into the scratches. The ink will spread in these scratches by capillary attraction. Now turn the scale over and stamp the numbers on the top side and fill them with ink also. Then with a 1/32 in. twist drill in a hand chuck, drill a counter bore on the kva. scale at the over each division, and at the zero division this hole is drilled clear through for the pivot. The graph paper is now attached to a sheet of bakelite or similar material and a common pin used for a pivot is cut to length and peened on the back to secure it in the sheet.

By placing the pencil point in the counter bore on the kva. scale at the correct division you can swing it to the kw. value and read the unknown. Most problems have kw. and kva. given so the counter bored holes really speed the operation; however, with any two values given the other two can be read easily.

Filing Stock Boxes Improves Service

WIRING

A novel system whereby "stock boxes" tailored to individual wiring jobs are stacked each evening in a "file" at the rear of the shop of AAS Electric Supply Company, St. Louis, has helped owner Arthur A. Smith carry out house wiring contracts more swiftly and effciently.

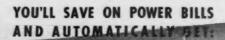
The stockbox system operates precisely the same as a business office file. A huge rack, ten feet tall and fifteen feet long, has been constructed at the rear of the AAS Electric Supply Company building, with four levels of shelving convenient to truck drivers parking in the yard. On the shelves are 50 stock boxes which are actually war surplus storage cabinets. These are painted bright silver, and identified with a label on the front of each, which gives the name of the building contractor, address of a specific building, etc., in which its contents are to be used. Mr. Smith paid 35 cents apiece for these boxes, and counts them one of his most valuable "speed assets."

The boxes are filled each evening by two shop stock men, who get the necessary information either from a bulletin board on which are clipped copies of plans for various jobs, lists of electrical needs for housing projects, commercial or industrial installations, etc. Where a large number of houses—up to 600 in a single project—are involved, the men who do the first wiring jobs run a quick survey on the remainder, and make out a de-

Reduce Your KVA Demand with

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Increased Load Carrying Capacity...

Regulation ...

Reduced Power Losses

Multi-Cell Construction with Famous
"TORRIDOL" Impregnant Means Assured
Dependability for Every Installation

The flexibility of Capacitron's Multi-Cell design provides an exactly correct capacity for every load requirement. "Torridol", the amazing capacitor oil that resists temperatures up to 600° F. without chemical change or decomposition, maintains one of the most effective safety factors ever developed against overloads. Thousands of "Torridol" units for Power Factor Correction are in use throughout the world. They have proved their ability to provide efficient, trouble-free service and a highly profitable investment to their owners.



Easy to Install.
Rubber Top Gasket
and Latch Make
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After hermetic sealing, Capacitron Multi-Cells go through 11 separate and rigorous performance tests before they take their place with others to make up complete Capacitron Multi-Cell Power Factor Correction units! Low voltage, 60 cycle; 1, 2 and 3 phase units are furnished in standard ratings of .5, 1, 2.5, 5, 7.5, 10 and 15 KVA for installation directly on the equipment or close by. 230 volt models come in sizes from .5 to 10 KVA. 460 and 575 volt units range from .5 to 15 KVA. Several units may be shunted to give greater total capacity. All may be used on lower frequencies with reduced KVA ratings. Automatic voltage discharge conforms with N.E.C. specifications.

While we recommend the use of low voltage capacitors wherever possible, we are in a position to supply Capacitrons in various sizes having ratings of 2,300, 4,000, 4,600, 6,900, 7,620, 11,950 and 13,200 volts.

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TELEPHONE VAN Buren 3322

CAPACITRONS—The Result of 17 Years in Capacitor Manufacturing



Stock boxes contain electrical ma-Stock ookes contain electrical material ordered for specific jobs by electricians at AAS Electrical Supply Co., St. Louis. Boxes are filled by stock men on the preceding day, ready for early morning pick-up by company

tailed report on the return trip which guides what goes into the stock boxes for that project in the future. "Each of our 15 electricians has this responsibility," Mr. Smith indicated, "taking into consideration such factors as brick or frame houses, type of lathing, plastering, etc., involved, amount of rough-in-work, brackets, and the types of load such as ranges, air conditioning, etc., which will be placed on the job. Where we handle a large number of small, individual jobs, the men take a complete rolling shop with them on the first day; thereafter, stockboxes for each job are sufficient.'

Removable white cardboard labels slip into holders on the face of each box. The stock men keep up a complete inventory after checking whichever source the information comes from. The next day's work requirements are always in place in the individual boxes, with the correct destination written in on the removable label, ready to be picked up at 7:00 A. M. the following morning.

Soldering Leads To Terminals

Any device or technique which will speed up production in this era of shortages is worth knowing about. Such a device is the holding fixture and soldering transformer (Fig. 1) used for soldering dynamotor leads to a terminal. It has greatly speeded up for soldering dynamotor leads.

production at the Small Motor Division of the Westinghouse Electric Corporation, Lima, Ohio.

Consider the old method of soldering one dynamotor lead at a time to a terminal (Fig. 2) which was previously used in this shop. The "holding fixture" was a plate with a hole drilled in it to suit the terminal. A copper tip soldering iron was used in the soldering operation.

With the new method, after the fixture holding the terminals is positioned with the left hand, the carbon electrode, which is connected to one of the transformer leads is lowered until it

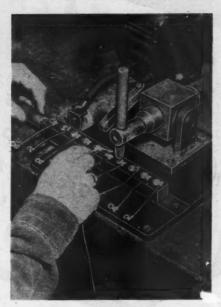


Fig. 1-Transformer and special holding fixture has greatly speeded up soldering of dynamotor leads in Small Motor Division, Westinghouse Electric Corporation, Lima, Ohio.



Fig. 2-Old method previously used

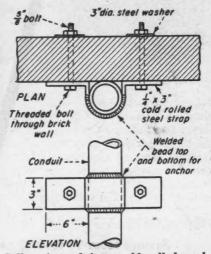
touches the terminal. This completes the circuit since the fixture is connected to the other transformer lead. Immediately when the circuit is closed there is enough heat created to melt the solder, which flows over the face of the clips.

Conduit Anchor

CONSTRUCTION

When running conduit up the side of a brick or concrete wall, the weight of the run can be evenly distributed and the conduit held in position without the possibility of slippage by using the procedure incorporated in electrical plans executed by Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

Cold rolled steel straps from 4 by 3-inch stock are formed as indicated



Collars formed from cold rolled steel hold conduit to face of building. Threaded bolts fasten collars to walls and compression is distributed by washers and nuts.

in the drawing. These straps are bent in an open collar, with diameters slightly greater than the ODs of the conduit, and the wings are drilled or punched to receive the shanks of §inch threaded bolts. The bolts pass through the walls of the structure and are secured on the other side by locking hex nuts. Compression is distributed over the surrounding surface of the walls by 3-inch diameter steel washers placed beneath the nut heads.

As conduit is placed in position, welded beads are placed around the conduit above and below the straps. These beads act as anchors for the conduit, provide support in the vertical direction and prevent creeping and slipping. The vertical spacing of the anchors is dependent upon the size of conduit and the overall vertical distance of the run.

WHY YOU SHOULD CONSIDER



COSTS LESS

Savings from 10 to 40% can be made in wire costs by using Hazard Performite Type RH aluminum wire instead of ordinary Type R copper wire. Even though Performite is a vastly superior insulation, its higher cost is more than offset by the low price of aluminum, which goes three times as far as copper on a weight basis. Further savings can be made in handling and installation costs, too.

FULLY APPROVED

For many years the National Electrical Code has permitted the use of aluminum for electrical conductors. The Underwriters' Laboratories, Inc. have approved the use of aluminum conductors subject to acceptance by local inspection authorities. U. L. approval labels are affixed to all Hazard Performite Type RH building wire containing aluminum conductors.

QUICKLY AVAILABLE

Hazard has been shipping and keeps available at the factory – for immediate delivery – a substantial amount of Performite Type RH aluminum building wire in standard sizes from 6 Awg to 750,000 CM, the sizes that are most difficult to obtain in copper wire. Furthermore, Hazard production schedules permit complete fabrication from aluminum rod to finished cable in 6 to 8 weeks where other sizes or non-stocked items are desired.

MAZARD T

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONSTRUCTION and MAINTENANCE you saw the item and they will send full details to you.

Equipment News

Fluorescent Luminaire

This new hingedglass fluorescent luminaire is known as the Aristolite. "Minute Maintenance" is claimed by the use of a servicing tool, which is used to clean the fixture from the floor. One end of the tool is a simple "gripper" for opening and closing the glass panels. On the other end is a duster for cleaning the unit. The diffusers are swung open and are held securely on the luminaire while relamping or other work is completed.

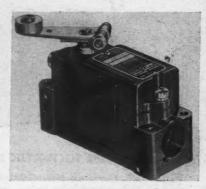


GUTH ARISTOLITE

They are available in two, three or four 40 watt sizes. They can be arranged individually or in continuous rows and mounted direct to ceiling or suspended on hanger. The Edwin F. Guth Company, 2615 Washington Avenue, St. Louis, Mo.

Limit Switch

The precision snap switch is now available in oil tight enclosures suitable for machine tool limit switch applications. The new limit switch is claimed to have higher electrical rating, longer mechanical life, and minimum size. Both surface and flush mounting arrangements are available and can be obtained



SQUARE D SWITCH

and can be obtained with either roller arm or pushrod operated mechanisms. The pushrod mechanism is designed for straight line operation and is not recommended for side thrusts. It is suitable for mounting in several positions. The one half inch conduit entrance can be made available at either end of the box by rotating cover and switch assembly 180 degrees. Square D Company, Industrial Controller Division 4041 North Richards St., Milwaukee 12, Wis.

Fastening Tool

Tempotool is a new powder activated hand tool for fastening operations on steel, concrete or masonry. Using a blank cartridge as the source of power, the tool shoots a threaded stud into place. Available in three sizes based upon the caliber of the charge-45, 38, and 22, the two larger sizes permit a choice of 3 charges to allow for various depths of penetration. A wide variety of projectiles are available including drive pins, male and female threaded stud bolts and punches. Range of operation claimed varies from Model 22 which will attach 1/8 inch steel to concrete up to Model 45



FASTENING TOOL

with a heavy charge which will sink drive pins 11/4 inches into mild steel. The Tempo Tool Company, Cleveland, Ohio.

Projector Spot and Flood Lamps

Development of new, compact 150 watt PAR-38 projector spot and projector flood lamps has been announced. The new lamps, which are supplementary to the standard line are equipped with side prong bases, thus reducing lamp and socket



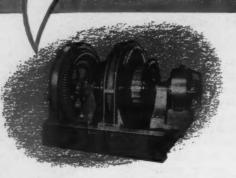
G-E LAMP

over all length approximately two inches. The new lamps were developed to meet a growing demand for lighting equipment combining fluorescent and filament lighting, particularly in the store lighting field. There are many other uses where space saving is important, such as installations recessed in ceilings, show windows, display cases and similar applications. The side prong base fits standard female separable connectors, but should be used only with heat resistant connectors. General Electric Lamp Department, Nela Park, Cleveland, Ohio.

SPECIALIZATION MEANS PROVED PERFORMANCE

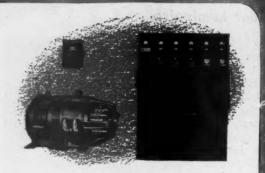
For 35 years, The Electric Products Company has specialized in the manufacture of High-Current, Low-Voltage Motor-Generators and other special electrical equipment. The result is Proved Performance... an assurance of lower-cost operation, higher operating efficiency and more dependable life-time service. For every application, E.P. designs and builds equipment that fits exactly the requirements of the particular operation.

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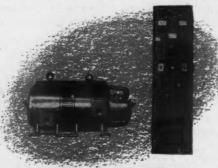
FOR ELECTROLYTIC PROCESSES

E. P. Electrolytic Motor-Generators employ Undercut Commutator Mica to prolong commutator and brush life; Pôle Spacers to help assure sparkless commutation; Micrometer Adjustment of Interpoles, an exclusive feature, to guarantee outstanding performance; Correct Mechanical Design that means every part of the motorgenerator is swept by a cooling stream of air; and Fully Accessible Construction for easy inspection.



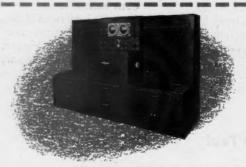
FOR INDUSTRIAL-TRUCK BATTERY-CHARGING

In 1910, The Electric Products Company introduced the first Automatic Battery Charger. Today they most efficiently and advantageously combine: completely automatic operation... the modified constant-voltage method of charging... individual application design ... elimination of complicated control or ventilating systems... and specialized low-voltage designing.



FOR STANDBY BATTERY-CHARGING

Since 1923, Diverter-Pole Motor-Generators have proved to be the most reliable, maintenance-free and efficient source of direct current for Control Bus Battery Charging. They assure maximum battery life, give full-automatic operation and protect themselves against harmful overloads. Requiring only infrequent inspection, they are extensively used in isolated automatic and supervisory-controlled substations.



FOR INDUSTRIAL TESTING

The design and manufacture of Dynamometers, because of the very high operating speeds and the severe continuous-duty loads, require a manufacturing skill far beyond that needed for conventional equipment: The Electric Products Company has developed this background. Features include oversize bearings, heavy supports and framework, special commutator and armsture construction.

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THE ELECTRIC PRODUCTS COMPANY

1734 CLARKSTONE ROAD

CLEVELAND 12, OHIO

Battery Charger

NCE

Flotrol is a new automatic constant voltage battery charger for telephone, railroad, standby or other applications requiring constant voltage direct current. Designed for floating operation, the charger consists of three elements, a magnetic control unit, selenium rectifier and filter choke. It compensates for variation in line voltage and load, operates automatically, is self protecting on overloads, and self cooling without fans. Available in



LORAIN BATTERY CHARGER

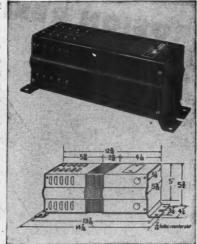
8 standard sizes for up to 24 cells. The Lorain Products Corporation, Lorain, Ohio.

NATIONAL ELECTRIC LOPO-TRIM

piece matching elbows are available. It has been approved as telephone wire raceway. It can also be used as a raceway for low potential services as buzzer and inter-communication wiring. It is particularly adaptable for residential, store and office applications. National Electric Products Corp., Chamber of Commerce Building, Pittsburgh, Pa.

Voltage Transformer

new constant voltage transformer designed to supply regulated voltage to domestic refrigerators and freezer units has been announced. can be connected to any standard unit employing a compressor motor not larger than one-fifth horsepower. It is identical in design and construction to the standard Sola constant voltage transformer except for a simple and rugged relay which operates only



SOLA TRANSFORMER

for a fraction of a second during each starting cycle. This new circuit arrangement prevents the current limiting characteristics of the constant voltage transformer from being effective until after the compressor motor has reached its normal running speed. Sola Electric Company, 2525 Clybourn Ave., Chicago 4, Ill.

Wiring Raceway

Lopo-Trim, a steel quarter round designed as a baseboard trim, a low potential wiring raceway, or as a quarterround trim above or beneath installations of plug-in strip, has been announced. Available in 6 ft. lengths, the 4 inch by 4 inch Lopo-Trim is installed without the use of nails, screws or fasteners. Projecting down from the back of the quarter round at 3 in. intervals are integral steel prongs. When it is installed, these prongs are pushed rounding external or internal corners, 8 in. by 8 in. two 157 W. Fulton St., Columbus, Ohio.

Yardlight

A new yardlight, designed for permanent all weather use including heavy snows and high winds, is now available. The one piece construction consists of a heavy aluminum 14 inch reflector and a 21



STERER YARDLIGHT

inch neck of ½ inch rigid pipe. It is claimed that this yardlight gives wide outdoor light distribution with a 150 watt lamp. It is furnished complete with socket, No. 14 wire, and cast aluminum wall flange including two hole insulating bushing, and 2 inch lag screws. Ample space is allowed under the flange for splicing. Steber Manufacturing Co., 2700 Roosevelt Road, Broadview, Ill.

Coupling-Connector

A new thinwall combination coupling-connector has been announced. Used with the nut it is part of the assembly, which may be used as a box or receptacle connector, without the nut it becomes a thinwall slip type coupling. Although it forms a straight, tight connection when the product is used as a coupling to assemble two lengths



CONDUIT COUPLING-CONNECTOR

of thinwall conduit on a parallel plane, it is flexible at the connection to allow slight deviation from the parallel, if desired. It has Underwriter's approval on pull test, rain down behind the baseboard or the plug-in strip. For test and concrete test. Conduit Pipe Products Company,



You can secure Central Rigid Steel

Conduit in three finishes, each designed for a particular purpose. The protective coatings are of the highest quality and are carefully applied under exacting standards of manufacture and inspection.

All coatings on Central Rigid Conduit likewise conform to the specifications of the Underwriters' Laboratories Incorporated.

To specify Central Rigid Steel Conduit is your best assurance of a protective raceway resistant to corrosive conditions and one that permits quick, easy pulling of cables without danger of damaged insulation.

It is not always possible to keep up with the constantly increasing demand for Central Rigid Steel Conduit. That's why at times your distributor may not be able to meet your requirements immediately. But keep in touch with him. He will fill your order just as fast as he can.

• SPANG-CHALFANT

Division of The National Supply Company

General Sales Office: Grant Building, Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

There's rested Strength in Every Length"

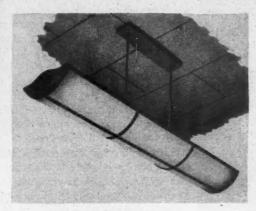
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Every length of pipe used to make Central Rigid Steel Conduit is carefully selected. It must have good ductility, strength and accurate diameter.

Fluorescent Fixture

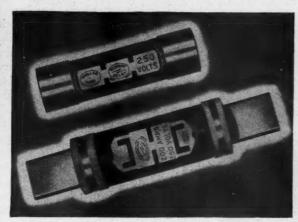
A direct-indirect fluorescent unit using two 100 watt lamps. Approximately 90 percent of the light is directed upward. The reflecting unit is white Vinylite plastic which is illuminated to the approximate brightness of the ceiling. E-Z servicer permits easy, quick access to the entire unit for cleaning and tube replacement. High power factor ballast. Can be mounted individually or in continuous rows. R. & W. Wiley, Inc., Dearborn at Bridge Sts., Buffalo, N. Y.



WILEY "ERIE" FIXTURE

Renewable Fuses

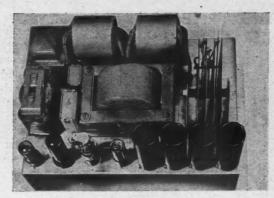
A renewable "time-delay" cartridge fuse that is designed to provide protection where time delay is needed, is now abailable. Fuses can be easily and quickly disassembled to insert new links. The knife blade type of these fuses is designed, precision made and assembled to maintain alignment of the blades under all conditions. The ferrule type is designed for easy accessibility. Both types are available in 250 and 600 volts, and in 1 to 600 amperes. Economy Fuse & Mfg. Co., 2717 Greenview Ave., Chicago.



ECONOMY RENEWABLE FUSE

Voltage Regulator

Regulated d-c voltages at currents and stabilities previously available only with batteries are now possible through a new line of voltage regulation units, called Nobatrons, it is claimed. They are available in six standard models, operate on a 95-125 volt a-c source of 50 to 60 cycles and provide amperages of 5, 10 or 15 with output voltages of 6, 12 or 28 respectively. Regulation accuracy



SORENSEN REGULATOR

of one half of one percent, maximum ripplevoltage (rms) of one percent and recovery time of one fifth of a second makes units suitable for critical applications where constant, unvarying d-c voltages are required. Control features include an on-off switch, a voltage adjustment, a control circuit fuse and a pilot light. Models are available either for panel mounting or encased in a cabinet. Sorensen & Company, Inc., 375 Fairfield Avenue, Stamford, Conn.

Industrial Tester

This industrial tester, Model No. 630, is for testing volts, ohms and amperes, both a-c and d-c. A single scale is used for making all voltage measurements. Operates on self-contained standard battery. No outside current is required. Suggested for use in repair work, testing, maintenance. Housed in oak cabinet complete with cover, battery, leads and instructions. Superior Instruments Co., 227 Fulton St., New York 7, N. Y.



SUPERIOR TESTER

Current Transformer

Announcement of a new 1200-volt indoor current transformer designed for metering service on three wire, single phase indoor circuits has been made. Designated Type JL-6, the new transformer is available in primary current ratings 10/10 to



G-E TRANSFORMER

400/400 amperes, and has been assigned a 30 kv. full wave rating. General Electric Company, Schenectady 5, N. Y.

WIRING A RESEARCH CENTER [FROM PAGE 45]

and corridors. Laboratory units are flush troffers measuring 20 feet in length and 12 inches in width, mounted 5½ feet on centers and recessed into the J-M tile ceiling. Two rows of 40-watt white lamps (10 in all) are installed in each run. Controlling lenses are of prismatic glass. Channel furring brackets are used to support both lighting units and ceiling panels. A consumption of 3.5 watts per square foot results in an illumination intensity of 40 footcandles on laboratory working areas. In corridors, mounting heights and lens design of fluorescent units are the same as for laboratory units, although units are spaced 11 feet on centers, contain two 40-watt lamps each, measure four feet in length and deliver an average illumination of 15 footcandles to glass-enclosed walkways.

Also included in the lighting plan are ceiling-recessed lensed units (200 watts) for shower rooms, locker areas and vestibules; dome reflectors (200 watts) for machine, storage and fan room; lensed in-built canopy lights (100 watts) at entrances, and exit lights, separately circuited.

A paging and transcription installation, zone and tone controlled, receives power through the lighting distribution system. Cabinet assemblies with amplification equipment, selector switch, record player turntable and microphone are located adjacent to the telephone switchboard. The factory area is served by 58 wall speakers, mounted 12 feet from the floor level. Along the center line of glassed corridors, 26 additional speakers are ceiling mounted.

All laboratory space is air conditioned, ducts being carried above ceiling lines with ornamental diffusing supply louvers set into the acoustical tile pattern, and return grilles located in exterior walls. Testing space is both air conditioned and humidified. The air conditioning system, utilizing 25 percent outside air and 75 percent recirculated air, has a capacity for 67,200 cfm.

The Research Center marks the inauguration of Johns-Manville's \$50,-000,000 world-wide expansion program devoted to the development of building materials and industrial products. Technical activities of the finished Center will include fundamental scientific research, product development, process improvement involving product quality, pilot plant and semi-work scale experiments, design and initial construction of new product equipment and the testing of building materials and industrial products.

The proximity of these multi-purpose activities in a single plant will permit simultaneous laboratory research, experimental manufacturing, and testing of full-scale equipment. This factor is of prime importance since durability of asbestos shingles, wall board, pipe and other related products depends as much upon how the ingredients are mechanically put together as they do upon the ingredients themselves. Items will be tested not only individually but also as completed assemblies. In one quick-cycle testing unit, it will be possible to subject entire roofs and building walls to 20 years of climatic changes during a six-month period.

By constantly improving production methods to capitalize on this type of research, future housing will have increased permanence and comfort through the use of lighter weight, fireproof, easily workable and economically-applied building materials.

The electrical installation was made by the Lord Electric Company in accordance with specifications and plans, prepared by consulting engineers Syska and Hennessey. The building was designed by architects Shreve, Lamb and Harmon and erected by the Turner Construction Company.



Running a construction project is no picnic today, says Henry T. Jensen, project superintendent for Harlan Electric Company, Detroit. Despite material and equipment shortages, he is making remarkable progress on the three million dollar electrical job at the Buick Motor Company plant in Flint.

UTILITIES BACK PLANNED LIGHTING [FROM PAGE 71]

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plan book. From the Better Light-Better Sight Bureau there will be made available educational booklets, motion pictures, slide films, newspaper and radio advertising suggestions, lecture outlines and demonstration ideas.

The major lighting market which the "Planned Lighting" program for schools seeks to tap will feature an attempt to teach "Light and Sight" away from home. Materials for the school project will be aimed at all levels of the school population, from elementary through high school, science and home economics classes. It will include bulletins, posters, pamphlets, and other material.

Equally detailed "Planned Lighting" programs have been prepared for the major markets which offices and factories represent. The wealth of supporting materials for these programs is equal to that supplied for the store, residential and school programs. The store "Planned Lighting" program is ready for use now. The remaining four programs will be ready within a few months.

Industry coordination will be fostered by sales training programs and cooperative advertising and promotion.

The "Planned Lighting" program will begin to hit its stride just as modern lighting equipments and components become available in much greater volume and variety. BL-BS, however, it is a long range program with almost revolutionary implications. It is the first nationwide lighting sales development program geared to an all-industry approach since the introduction of fluorescent lighting. Facing a practically unlimited market, the outlook is bright. But the lighting market can only be developed to its full potential by a creative approach that heretofore has been rarely evident in lighting sales.

If effective industry coordination can be achieved, it will be a contractor show. Experienced selection of equipment and skillful installation are inherent parts of planned lighting and the planning must inevitably take up the vital elements of adequate wiring and convenient control. Electrical construction, installation and maintenance firms in every community have a large stake in the successful development of the campaign.

MEETING POLYPHASE REWIND TIME SCHEDULES

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[FROM PAGE 73]

insulation, we simply insert pieces of asbestos paper (moistened just before welding) between each connector. Practically all stator connections are welded with phoscopper rod which makes a perfect bond and eliminates tedious wire scraping.

After each winder tests his own work for shorts and grounds, it is picked up by one person who does all the dipping and baking. For those shops having insufficient volume to employ a full time insulation cutter, stripper, etc., I suggest assigning a combination of these lesser chores to one individual.

Reassembly, Testing, Painting

The reassembly man plays an important part in determining what kind of a reputation we have with our customers. His duties are to see that the stator windings are cleaned and sprayed with a finish varnish; install bearings; assemble and test each motor. His equipment should include speed wrenches, a power brush for cleaning, and testing equipment for ground and rotor tests.

General Features

An efficient material handling system is necessary to speed up the flow of repairs through the shop. We recently installed a complete monorail system by which we can transfer equipment to almost every part of the shop. It is proving to be a worthwhile investment.

Metallizing is speeding up the work of the machine department. With it we can build a shaft up to standard size in less time than it takes to make undersized bearings. Special eutectic alloys are being used to weld cast iron, make shaft extensions and similar operations.

Every motor shop operator realizes the need for reducing costs. Increasing repair efficiency is one answer to the problem. The NISA Rewind Time Schedule provides a practical yardstick for measuring shop department operating efficiency. If the limits seem too low for your specific case, something may be wrong with your shop methods. Check now and improve them. Our methods are far from being perfect. However, I hope some of the above ideas will be of benefit to other shops.



Let CHAMPION Experts INVESTIGATE!

Champion's lighting engineers are interested only in helping you to get better lighting and thereby increase your production efficiency, safety, working morale and lighting economy. Their unbiased recommendations are freely available to every user of Champion Fluorescent and *Incandescent* Lamps.

Whatever your lighting problem, large or small, you will find it profitable to take advantage of the Champion combination of lamps of fine quality and lasting dependability, supplied by a competent local distributor who knows industrial service needs and backed by competent lighting engineering counsel.





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Quality Distribution and Quality Product seek, and find, each other. That is why the leading Distributor in your community is almost certainly the Bunting Authorized Distributor. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Branches in Principal Cities.

BRONZE BEARINGS

BUSHINGS

PRECISION BRONZE BARS

Motor Shops

Lathe Type Coil Winder

Sorensen Electric Co., Salt Lake City, have a coil winder that they say is almost a museum piece, but so effective that they have never tried to change or replace it. It is of the lathe type, now used largely for winding transformer coils, but it can be made to do most anything in the winding line.

A motor at the far end drives a shaft by V-belt, this shaft being connected to two Chevrolet transmissions in tandem, mounted on top of the machine. The reason that there are two is because rather heavy loads are carried at times.

The end of the shaft beyond the transmissions carries a bevel gear, which drives the shaft of the lathe head. This head is an old Ford wheel with brake drum attached, the brake being operated by a foot pedal. A chuck-like arrangement is then fastened to the face of the wheel and to this the coil form is attached so that it turns with the wheel.

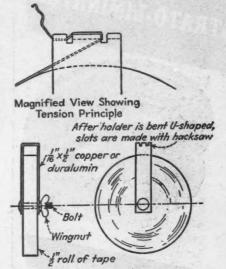
The main shaft of the lathe extends clear through wheel, chuck and coil, and at the near end to the observer, in the photograph, is carried on movable supports, these supports being carried on an angle iron track in the lathe bed. This arrangement is extensible and allows for handling the largest work.

Combined in one machine are facilities for large work, small work and low speed or high speed. On the floor back of the operator's seat are the jacks for the wire spools. Note the mirror at the operator's left. This is so placed that he has only to glance into it to note the operation of his wire pay-off.

Tension Bracket For Hand Taping

When taping armature or stator coils, the mechanic must be careful to make a tight "wrap" each time the tape circles the coil. This is important whether the job is done by hand or with a taping machine.

To assure a tight wrap on all hand taped coils, the motor shop department of the Hagerstown Equipment Company, Hagerstown, Md., devised a simple tension device that fits on a standard roll of ½-inch cotton or cambric tape. The holder is a U-shaped bracket of copper or duralumin (see illustration) long enough and of sufficient width to permit free rotation of the roll. After the bracket has been



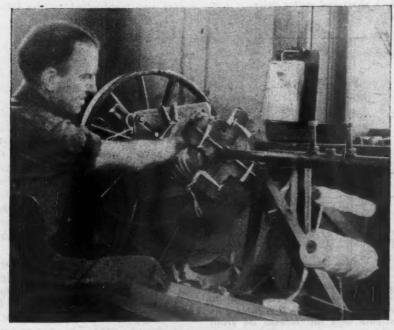
Details of a simple tension bracket designed for use when hand taping motor coils. (Courtesy, Awards Committee, National Industrial Service Association.)

fastened to the roll with a bolt and wing nut, the tape is threaded through two slots cut in the top of the holder to provide tension when the tape is being wound around the coil. Another reported advantage is the ease with which a mechanic can handle a roll of tape equipped with this device.

Vibration-Free Lathe Drive

A. W. White, A. W. White Electric Motor & Machine Co., Oklahoma City, has successfully eliminated "work chatter" on smaller lathes in his shop by devising a free-standing independent motorized drive. Only mechanical connection between drive and lathe is the flat belt connection to the lathe pulley.

A sheet steel cabinet, 54-in. high, 20-in. deep and 24-in. wide, encloses the complete drive. Near the top of the cabinet is a 5-step pulley jack shaft mounted to adjustable arms which pivot about a horizontal pin. Driving this pulley, through a flat belt connection, is a 5 hp., 1200 rpm., 220-volt, 3-phase motor mounted to a hinged base near the bottom of the cabinet (Fig. 2). A foot operated lever, connected through a linkage to the jack



A museum piece, but it works.

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VENTILATION
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Low Cost year Fround Ventilation for Every Need

Strato-Liminator Model 110 shown above, recirculates air completely every 3 minutes in 5,000 cu. ft. of space—without direct drafts. Special louver design insures even circulation to all parts of average room. When temperature at ceiling level of room rises above normal, unit turns itself on. Thermostat settings range from 55° to 85°. Speed of rotating blades adjusted by simple manual control. Write today for folder A-1 and prices. Sold only through wholesalers—offers year 'round sales opportunities.

Therinostatically sentralled for automatic operation.
Cool, no-draft ventilation in hot weather fuel-saving heat diffusion in cold weather.
Dissipates stale air and unpleasant odors.
Easy to install

WILSTER, inc.

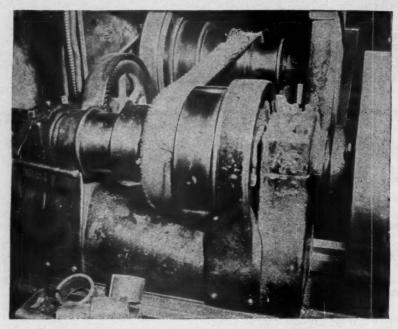


FIG. 1—Front view of belt connection between jack shaft and lathe pulley—only mechanical connection between drive and lathe.

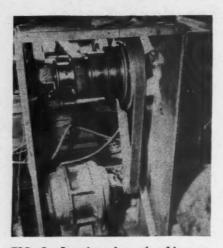


FIG. 2—Interior view of cabinet enclosing independent lathe drive showing jack shaft and motor drive.

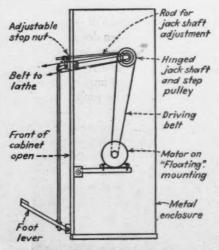


FIG. 3—Sectional view of cabinet and drive showing foot lever connection to jack shaft. Belt tension is regulated by adjustable stop nut located on front of cabinet.

shaft frame and equipped with an adjustable stop-nut, permits adjustment of jack shaft angle for proper belt tension; also facilitates quick change of belt on step pulleys (Fig. 3). The channel iron base of the cabinet is securely bolted to the shop floor. The front of the cabinet (facing the lathe) is open permitting free belt and electrical connections.

Electrical connection to the motor is made by flexible conduit and plug to a 3-wire receptacle mounted to the back of the lathe bed. A similar connection is made to the motor control switch on the lathe.

With the driving unit entirely independent, White reports that any vibration set up by the motor and shafting is not transmitted to the lathe. Result: No work chatter.

Two-ton Shop Crane

The Thomas Electric Co., Salt Lake City, is operated by H. L. Thomas and his two sons, Jack and Henry Thomas. They have a well-equipped motor repair shop but when the war rush came what they needed most was a traveling crane, then unobtainable. This fact did not stop them, however, for they built a very satisfactory one themselves at a total cost for materials and labor of about \$4,500.

For track, extending the full length of the 70-ft. building, they used light car rail carried on reinforced wood stringers. The span is 35 ft. and for the trayeler an I-beam with about a 6-in. web was used. This was mounted



This man is looking at a convenience outlet. He once thought that only a customer would find it "convenient." But now that he has changed to General Electric, he has discovered that easy handling and easy installation give extra meaning to that term. He has learned that this outlet, GE 2679 — and a wide variety of other General Electric wiring devices — have been designed to help make his job less difficult. Plaster ears are included to make mounting simpler. T-slots provide extra leeway in positioning. Durable brown or ivory color body improves appearance, and assures long service. Even more important, a wide range of sizes, types, and capacities allows him to select the proper outlet for any job from a single source of supply.

But the real convenience comes when this man (and thousands like him) mentions the name behind the product — General Electric. It gives customers extra faith in his good judgment. It helps him to be sure that the wiring he installs will give long-term service. And it makes it easy to order with confidence any item in the full line of wiring devices. Just say G.E., and he'll agree.

WIRING DEVICES by

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Wiring Briefs from your G-E Distributors

Are you familiar with the great variety of products in General Electric's full line of wiring devices? Do you know the interesting features that help to make them easy to use and easy to sell? Keep an eye on this column, and you may discover a lot of useful facts and information. We'll keep dishing them out for you.

Here's the switch for nurseries, theaters, and other places where silence is important. So quiet that you can't hear it operate, this silent General Electric mercury switch has no moving parts to wear



out. It's a top-quality product that goes a long way in pleasing your customers.

How often have you had customers complain because of faulty power cords on lamps and appliances? General Elec-

tric's durable Flamenol® cord sets put a stop to these complaints, because they practically never wear out. Strong, age-defying, easily cleaned Flamenol cords are equipped with moldedon plastic plugs that are virtually indestructible.



Preassembled at the factory, Flamenol cord sets are supplied with conductors stripped for speedy installation. Use them on all light appliances, to add the extra evidence of quality that is the hallmark of General Electric — and your best bet for satisfied customers.

Rural America is "going electric" fast. And now is a good time to remind you that General Electric makes a complete line of

surface wiring devices to help you get a share of the profitable farm wiring business. G-E surface wiring devices are strong, light, easy to install, and popular everywhere for farm buildings, camps, garages, warehouses, or



temporary wiring. Let us give you a descriptive folder.

If you want additional information on these, or other G-E Wiring Devices, ask us — your G.E. Merchandise Distributor — or write to Section D60-518, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut.

*Trade-mark Reg. U. S. Pat. Off.



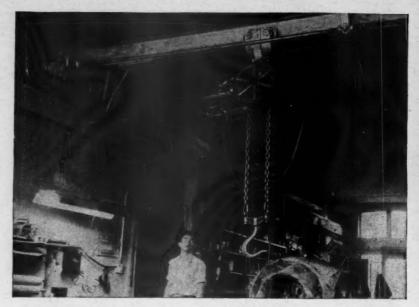
Yes, P&S know-how, resulting from over fifty years' experience in the manufacture of precision-made wiring devices, gives you these important features:

- Rugged Construction
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- Easy, quick installation
- ●Long life contacts that hold lamps securely
- Ample binding screws (backed out and spun)
- Finding slots that simplify removal and replacement of lamps
- Approved by Underwriters' Laboratories

DEPENDABLE DELIVERIES

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PASS & SEYMOUR, INC. SYRACUSE 9, N. Y.



Shop Crane built by Thomas Electric Co. at a cost of \$4,500

on a truck at each end mounted on a pair of old hand car wheels, motorized with a 5 hp. rebuilt motor and a gear reducer secured from a discarded road scraper.

For the hoist, an old Yale hand operated hoist was converted into an

electric hoist with a rebuilt 3 hp. motor. Both hoist and travel motors are controlled by ropes from the shop floor. Con

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The crane has a capacity of two tons and it will travel the length of the 70 ft. building in approximately one minute.

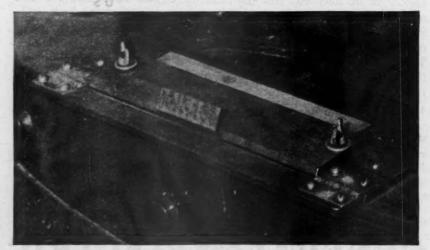
Slot Paper Formed By Hinged Creaser

Opening their new shop at a time when equipment was unavailable made it necessary for the partners of the Mo-Gen Electric Company of Stamford, Conn., to improvise several devices which are standard equipment in the average shop. One of their shop-designed aids is a metal paper creaser for forming the slots in insulation paper.

The device consists of four metal sheets, two hinges and locknuts. Two of the heavier sheets are loosely connected by piercing bolts and can be clamped together by turning wing nuts.

A thinner sheet is placed between these two and can be moved in or out between them to vary the depth of the metal groove so formed. The fourth plate is hinged to the front of the lower, main plate and can be flipped upwards with a movement of the operator's thumbs.

In operation, the paper is inserted into the steel groove, the hinged section flipped up to crease the paper, the paper is reversed for a similar treatment of the other side and the formed insulation paper is ready for insertion into the winding slot.



In the absence of manufactured equipment, ingenuity aided a new company in designing much of the shop's standard equipment. The insulation slot former is one of several such ideas employed.

Questions on the Code

Common Neutrals vs Multi-Wire Circuits

Q. In Article 210, Section 2111 it states, branch circuits may be installed as multi-wire circuits. Is it permissible to install a 3 wire No. 12 or 2 No. 12 and 1 No. 14 multi-branch circuit in a house? One circuit for the appliance circuit and the other for lighting?

Our inspector says it is not permissible to tap the neutral conductor of the appliance circuit and we have to run either 2½ inch or 1½ inch conduits to pick up our basement lighting and appliance plug at the laundry.

Since this neutral is all tied together at the main panel I cannot agree with him.—M.L.M.

A. There is no violation of the Code in combining a 20 amp. and a 15 amp. branch circuit across a 3 wire system, provided the service feeding the installation is a 3 wire (110-220 volt) one and provided that one of the No. 12 wires is used for the neutral and that the other two wires (one No. 14 and one No. 12) are not of the same polarity.

The 3 wire (2 No. 12 and 1 No. 14) could be run in one ½ inch conduit without violating the Code.

The use of a common neutral to serve several branch circuits is now prohibited.—F.N.M.S.

Motors for Hazardous Locations

Q. We are building hammer and attrition mills and in the past have used totally enclosed motors on them. Recently we were told that we would have to supply labeled dustight motors and when we attempted to order them, the supplier advised us that not only would delivery be delayed for months but such a motor would cost approximately \$100.00 more per

unit. It seems the manufacturers make only one type of motor now that is capable of being labeled as either a Class 1 or Class 2 motor. Will the new code require that such a motor be labeled, or may we continue to use totally enclosed motors?—R.O.

The Code will require the use A. of an approved motor and inasmuch as practically all inspection departments depend upon the Underwriters' Laboratories label, you apparently have no alternative. Section 5058 of the 1947 Code states that motors shall be totally enclosed not ventilated, totally enclosed pipe ventilated or totally enclosed fan cooled, and shall be approved for Class 2 locations. Previous editions of the Code did not contain the words "and shall be approved for Class 2 locations". While it is true that the Code definition of the word "approved" does not refer to the Underwriters' Laboratories label but reads "Acceptable to the authority enforcing this code", it is also true that very few such authorities have any facilities for determining whether or not devices such as motors are safe in hazardous locations.-G.R.

Transformer Vault

Due to conditions over which we have no control, we have to construct a transformer vault in the center of a fair sized two story building. We had planned to use transformers containing synthetic dielectric, but because of delivery problems we will use regular oil filled units. What will the Code require in the form of ventilating ducts from the transformer room to the outside of the building?—J.P.

The Code states that transformer vaults containing oil insulated transformers shall be ventilated by means of noncombustible ducts in accordance with requirements found in the American Standards for Transformers No. C. 57.1. In gen-

eral this requires a room temperature not over 104 degrees fahrenheit. Inasmuch as a vault located some distance from an outside wall or roof may require too large a ventilating duct to permit the use of gravity alone, it may be well to consider forced ventilation. In any event, the discharge duct should leave the vault at a point as high above the transformers as is possible, and the intake duct must be above the door sill level. Each ventilation opening must be provided with automatic dampers preferably of Class A rating. For ducts not exceeding 18 inches in diameter the damper may be a inch steel plate, preferably dropped by gravity in a vertical position. If natural ventilation is used, the vent duct will have to have a cross-sectional area equal to three square inches per kilovolt-ampere of transformer capacity. These requirements will be found under Section 4545 of the Code.-G.R.

Plug Fuses On 250 Volts

I am uncertain as to the interpretation of Article 2403 in regard to the use of plug fuses on 230 volt motor branch circuits. Of course the service to the building will have a grounded neutral and each conductor to the motor will be less than 150 volts to ground. The equipment will of course be grounded. Does this permit the use of plug fuses for motor overload protection?

Under 2451a classification; I assume this paragraph should be interpreted as 125 volts to ground.—E.S.S.

The second sentence of Section 2403a permits the use of plug fuses on circuits connected to a supply system having a grounded neutral and no conductor at more than 150 volts to ground. This would permit plug fuses to be used on 230 volt motor circuits connected to such a system.



This is permitted on the theory that the fuses which are rated at 125 volts would blow two in series across 230 volts or at approximately 115 volts across each fuse. Such practice, however, is not to be encouraged for if one of the fuses was slower than the other in blowing, the one which does blow would be opening 230 volts and sometimes plug fuses blow up when opening on that voltage.—F.N.M.S.

Service Entrance Conductors

Whenever possible I have made a practice of placing the service pothead above the level of the wire rack or house knobs, but occasionally the eave of a building is too low to make this practical. In the past our inspector has made us remove some of the insulation at the low point of the drip loop on such buildings. Will this be required by the new code?—C.K.

No, the 1947 edition of the N. E. Code will not require that ½ inch of the insulation be removed. Instead in Section 2337 you will find the following sentence: "To prevent the entrance of moisture, service-entrance conductors shall not be connected to service-drop conductors at a point above the level of the service head or the termination of service-entrance cable sheaths".

The idea behind this change in rules is based on the simple rule of hydraulics pertaining to head. Locating the solderless connector below the level of the service head will accomplish the same result that removing the insulation from the bottom of the drip loop will, as the moisture that does penetrate the insulation will not be pushed uphill and then into the service raceway or cable.—G.R.

Transformers for Cold Cathode Tubing

I have been asked to approve a neon lighting system in a new night club in which ordinary 15,000 volt sign transformers have been used. The tubes and wiring seem to be well designed and carefully installed, but there is some question in my mind about the use of 15,000 volts. Section 6011 apparently permits 15,000 volts on such installations. However, I have read of some limitations

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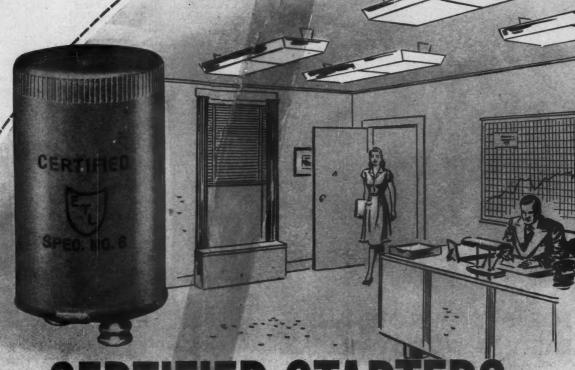
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In offices, stores or factories . . . wherever large numbers of fluorescent lighting fixtures constitute a maintenance problem, CERTIFIED STARTERS produce real economies. CERTIFIED STARTERS are tested, checked and certified by famous Electrical Testing Laboratories, Inc., as meeting rigid specifications for performance and service. That means more light from lamps, longer lamp life, longer starter life. Be sure the starters you sell or use carry the familiar "ETL CERTIFIED" shield!

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The Arrow-Hart and Hegeman Co., Hartford, Connecticut The Bryant Electric Co., Bridgeport, Connecticut Dura Electric Lamp Co., Newark, N. J. General Electric Co., Bridgeport, Connecticut Harvey Hubbell, Inc., Bridgeport, Connecticut

Instant Glow Starter Corporation, New York, N. Y. Kuthe Laboratories, Inc., Newark, N. J. The Lloyd Products Co., Providence, R. I. Pass & Seymour Co., Syracuse, N. Y. Sheldon Electric Co., Irvington, N. J.



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CHIMES

HERE is a line of quality chimes you'll be proud to recommend and install—because they're styled in eleven beautiful, colorful models to harmonize with any decorative scheme—and because they're engineered for many years of positive, trouble-free action.

Tubular Faraday chimes have the new, exclusive "tone crown" tube hangers (all metal—no strings) which assure richer tones and a minimum of swinging. And, as you know, Faraday chimes are widely advertised in the best-read national magazines, so you'll find ready acceptance for them among your customers. Fair trade prices, \$3.95 up.

Write today for full information!





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which should be placed on this type of lighting. Will this be found in the new code?—B.W.J.

Yes, Section 4194 will limit the secondary current rating of a transformer supplying cold cathode tube for lighting installations at an open circuit voltage in excess of 7,500 volts to 120 milli-amperes. Transformers rated at not more than 7,500 volts shall be limited to 240 milli-amperes, and no transformers rated in excess of 15,000 volts shall be used. The Code does provide that on test such a unit may exceed its rating by not more than 1,000 volts.—G.R.

Grounding of Portable Equipment

The question is on two portable electric welder machines (that is, they are on wheels and moved from time to time) which I define as portable equipment. One is a 400 amp. welder connected to a 30 hp. 440 volts 3 phase induction motor and the other one is a 200 amp, machine connected to a 15 hp. 440 volts induction motor. I claim that the Code requires that these machines be equipped with an equipment ground and that this ground must be part of the cable assembly and must be so connected that this ground cannot be disconnected without first disconnecting all the circuit conductors or all be disconnected at the same time.

I am told that a separate ground conductor can be connected to these machines and that a four conductor cable is not required by the Code. I claim that this is not correct and does not meet the Code requirements as these separate grounds are not pro-tected against being broken or disconnected without disconnecting the circuit conductors. The cables on these machines now are three conductor rubber-sheathed cable. I claim this cable must be replaced with four conductor cables, or the present cables put in flexible conduit with the proper fitting on each end to make this flexible conduit act as a permanent ground conductor. Am I right?-W.H.C.

As the motors on these welding machines operate at more than 150 volts to ground, they must be grounded in order to satisfy rules 2545b and c. Then, under "Methods of Grounding" rule 2559 states that portable equipment may be grounded by "means of a flexible wire*** protected as well as practicable against

mechanical injury." There is nothing in the Code about simultaneous disconnection of the circuit with the grounding.—F.N.M.S.

Fluorescent Fixtures

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Q Several stores here are displaying fluorescent fixtures designed so that they can be supported by the shell of a light outlet. I do not believe they are approved, but now when fixtures are so difficult to get can we use them?—J. E. H.

A Section 4131 of the N. E. Code says that a fixture that weighs more than six pounds or exceeds sixteen inches in any dimension shall not be supported by the screw shell of a lampholder. This new provision was written into the Code to prevent the supporting of such fixtures from lampholders.—G. R.

Wiring for a Drying Tunnel

When wiring up a drying tunnel consisting of a number of infra-red lamp banks, is it possible to use higher voltage circuits and wire the lamps in series?—C. F.

A. Yes, provided the lampholders have a voltage rating not less than the circuit voltage. The Code now contains a section applying to infra-red installations, this is Section 4237 and it reads as follows:

"Infra-red heating lamps rated at 300 watts or less may be used with lampholders of the medium base unswitched porcelain type or other types approved for the purpose. Screw shell lampholders shall not be used with infra-red lamps over 300 watts rating unless the lampholders are especially approved for the purpose. These lampholders may be connected to any of the branch circuits of Article 210 and, in industrial occupancies, may be operated in series on circuits of more than 150 volts to ground providing the voltage rating of the lampholders is not less than the circuit voltage." Then in a fine print note following this section is found the following recommendation: "Each section, panel or strip carrying a number of infra-red lampholders (including the internal wiring of such section, panel or strip) is considered an appliance. The terminal connection block of each such assembly is deemed an individual outlet."-G. R.





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Methods of Starting Polyphase Squirrel-Cage Motors

At the present time, there are in use several methods of starting polyphase squirrel-cage motors. The most important of these methods are listed below in relative order of their importance:

A-Full voltage starting.

(Most important and most common method of starting)

B—Compensator or auto transformmer starting.

(Most common method of reduced voltage starting)

C-Korndorfer starting.

(Variation of autotransformer starting used under special line conditions)

D-Primary resistor starting.

(A less common method of reduced voltage starting)

E-Y-delta starting.

(Special method of starting seldom used in this country)

F-Reactor starting.

(Reduced voltage method occasionally used, principally with large motors.)

I. Description—Methods of Starting Polyphase Squirrel-Cage Motors A—Full Voltage Starting

When a squirrel-cage induction motor is thrown directly on the line, a sudden rush of current occurs. The duration of this current rush depends upon the time required for acceleration, which in turn depends upon the load to which the motor is connected. The magnitude of this current depends solely on electrical factors of the motor design.

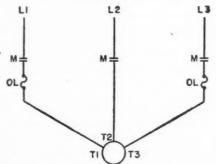
This inrush current is a factor to be considered when throwing motors on the line and when large motors are involved, this current may affect voltage regulation. In some cases the full voltage starting torque may be excessive for the driven machine and should be reduced when starting. The motors E. D. McCulloch Control Division General Electric Company Schenectady, N. Y.

themselves, in most sizes, are braced to stand the starting stresses when full voltage starting is used.

There are many advantages to be gained by full voltage starting or throwing the motor directly on the line. These advantages are:

- It is the simplest method of motor starting and, therefore, the easiest to install.
- It requires a minimum amount of equipment and, therefore, is the most economical method of starting.
- 3) It requires the least amount of maintenance.
- 4) The actual energy used in starting the motor is less with this method than with any other method, and the heating of the motor is considerably less.

Another factor to be considered is that a very large motor, when thrown on the line, may draw a current high enough to interfere with the voltage regulation of the power distribution



L - Power source
M - Line contactor
OL-Overload

Note: Sequence
(I) M contactor closes

FIG. 1-Full-voltage starting

system. This interference is negligible in most applications and for that reason it has for a long time been permissible and the accepted standard practice to start most motors on full voltage.

A typical wiring diagram for full voltage method of starting in shown in Fig. 1.

Full voltage starting of motors is generally the most economical method of starting. In addition, modern motors are designed not only to withstand full voltage starting, but also designed with relatively low starting current making them generally acceptable for full voltage starting on most polyphase power lines.

B—Compensator or Autotransformer Starting

Starting by means of a compensator or autotransformer is such a well known method that it hardly seems necessary to describe it. It gives reduced voltage starting by applying a reduced voltage from a tap of an autotransformer to the motor terminals, and cutting the autotransformer out of the circuit and applying full voltage on the motor. The chief merit of the compensator or autotransformer is that, because of its inherent design, it can stand longer periods of acceleration and more frequent operation than other types of reduced voltage starter. It has another advantage because its voltage taps can be used to meet a rather wide range of starting torque requirements.

One disadvantage of compensator or autotransformer reduced voltage starting is that a high peak of current may take place momentarily when connection is made to the line after the motor is momentarily disconnected from the starting taps. Tests have shown that, while this peak of current may be higher than with starters

which do not disconnect the motor, it is of very short duration —too short to cause flickering of lights or general voltage disturbances—and an oscillograph would be required to detect these peaks. This current peak occurring at the transition naturally has an effect upon motor windings, but this effect is not appreciable until ratings of several hundred horsepower are reached. For very large motors the Korndorfer method of starting is used.

A typical wiring diagram of the compensator or autotransformer method of starting is shown by Fig. 2. C—Korndorfer Starting

The Korndorfer method of reduced voltage starting involves the use of a special switch arrangement of autotransformer starting which puts the motor on tap voltage, and then opens the Y-point of the autotransformer, thus leaving those sections of the autotransformer between the line and the taps in the line functioning as a series reactor. This maintains current and voltage on the motor without completely breaking the circuit, as is done with the compensator. It also gives the effect of another starting step. The third step of operation in this method is to close the running switch, which short circuits the series reactor sections of the autotransformer and applies full voltage to the motor.

A typical wiring diagram of the Korndorfer method of starting is shown in Fig. 3.

D-Primary Resistor Starting

There are two kinds of primary resistor starters now in use. One is the single-step type, and the other is the stepless or compression-resistor type. With either type it is possible to simply short circuit the resistor and, therefore, no great transition

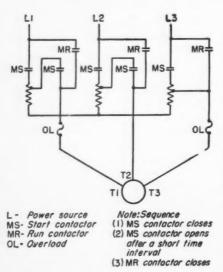
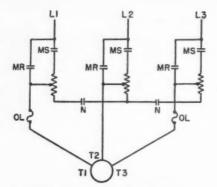


FIG. 2—Compensator or autotransformer starting



L - Power source
MS- Start contactor
MR- Run contactor
N - Auto transformer
Neutral contactor
OL - Overload

Note: Sequence
(I) MS contactor closes at same time N contactor closes
(2) N contactor opens after

(2) N contactor opens after a short time interval (3) MR contactor closes (4) MS contactor opens

FIG. 3-Korndorfer starting

peak of current is obtained. This is not a strong argument in favor of the resistor starter inasmuch as it can be designed only for use with relatively small motors on which the accelerating peak current is negligible.

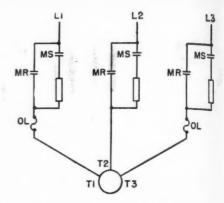
The stepless resistor starter will give comparatively smooth acceleration of the motor if it is carefully operated and the load to be started is not heavy. However, if the load requires considerable starting torque, it becomes necessary to cut out a large portion of the resistance before the required torque is developed, and when the remainder of the resistance is shorted, the effect on the line is very much the same as when using a one-step resistor starter.

It is not feasible from an economic standpoint to build primary resistor starters for low voltage motors of large horsepower rating, or for high voltage machines. The primary resistor starter is suitable for applications such as centrifugal pumps where the starting duty is light.

A typical wiring diagram of the primary resistor method of starting is shown in Fig. 4.

E-Y-delta Starting

For certain special applications largely in foreign countries, it has been found advisable to furnish squirrel cage motors with both ends of all phases of the stator winding brought out to the conduit box. Then, by a suitable switch, the stator winding of the motor can be connected "Y" for starting and delta for running. This gives the same effect as connecting the motor to a line with 58 percent of normal voltage. This method of starting cannot be applied generally, since only one value of starting torque, and a rather low value at that, can be obtained. The saving in cost of the motor and control us-



L - Power source
MS-Start contactor
MR-Run contactor
OL - Overload

Note: Sequence
(1) MS contactor closes.
(2) MS contactor opens
after a short interval
of time
(3) MR contactor closes

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FIG. 4—Primary resistor starting

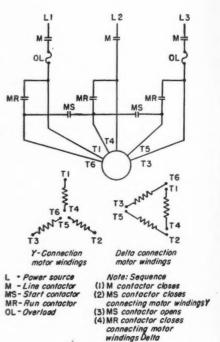


FIG. 5-Y-delta starting

ing the Y-delta method of starting is not as great as might be expected. Because of limited applications, these motors must be brought through the factory as special machines, resulting in higher costs. Adding the cost of a suitable switch giving overload and under-voltage protection, the total cost of motor and control is brought up to a point where little if any saving is realized.

A typical wiring diagram of the Y-delta method of starting is shown in Fig. 5.

F-Reactor Starting

Starting by means of a reactor gives reduced current by inserting a reactor in series with each of the motor leads and then cutting these reactors out of the circuit and applying full voltage to the motor.

This method of starting gives a smooth start with long accelerating time and a low value of accelerating torque. The voltage at the motor terminals and the percentage of full-voltage torque gradually increase as full speed is approached, until the motor terminal voltage reaches almost normal value before the reactor is short-circuited and full voltage applied to the motor.

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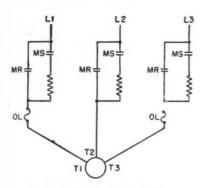
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Typical wiring diagram of the reactor method of starting is shown in Fig. 6.



L - Power source
MS- Start contactor
MR-Run contactor
OL-Overload

Note: Sequence
(1) MS contactor closes
(2) MS contactor opens after
an interval of time to allow
motor to come up to speed

FIG. 6-Reactor starting

II. Comparison—Methods of Starting Polyphase Squirrel Cage Motors. Before applying the various methods which are available for reducing starting current and improving line-voltage conditions, it is important to have a

ing current and improving line-voltage conditions, it is important to have a thorough understanding of the effects of reduced voltage starting on the motor, as well as on the power system.

Modern motors are usually available in both normal and high starting torque designs. Any method of starting which reduces the current to the motor is accompanied by a reduction in torque. Therefore, it is essential to know something about the loadtorque characteristics in determining if a given current limitation can be met. In other words, there are boundary conditions in which the permissible current to be taken from the line would not provide the needed output torque at the motor shaft, necessary for the successful starting and acceleration of its connected load. With all starting methods, the torque of the squirrel-cage motor varies as the square of the applied voltage to the motor terminals.

In the case of the autotransformer type, the current taken from the line also varies as the square of the voltage applied to the motor terminals, and it is convenient to remember that the

torque and line current are reduced at the same rate. Thus, an autotransformer starter, designed to apply 80 percent of the line voltage to the terminals of the motor, will produce 64 percent of the torque that would have been developed if the motor had been started on full voltage, and will at the same time draw 64 percent as much of the current from the line as would have been required for full voltage starting. Fig. 7 shows a linecurrent versus time curve of the autotransformer method of reduced voltage starting. Note that curves are plotted for both 65 and 80 percent applied voltage to the motor. In each case, the reduction in motor torque is evidenced by the longer time required to accelerate its connected load. It should be further noted that the lowest voltage tap while giving lower initial inrush current, provides a higher current peak when the transition to full voltage occurs. This is because the acceleration to full speed takes place from a lower initial speed. Fullvoltage starting conditions are shown in Fig. 7 for comparison.

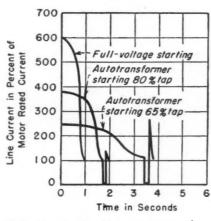


FIG. 7—Accelerating current of a squirrel cage motor driving a loaded centrifugal pump, full-voltage vs. autotransformer starting.

With resistor or reactor starting, the starting current varies directly with the voltage at the motor terminals, because the resistor or reactor is in series with each line to the motor and must carry the same current that flows in each motor terminal. It is evident, therefore, that the resistor and reactor types of reduced-voltage starting require more line current in amperes per unit of torque in footpounds than does the autotransformer type. This is shown clearly in Fig. 8, where a motor driving a loaded centrifugal pump is started on the 80 percent tap of an autotransformer, and also with a primary resistor limiting the starting voltage to 65 percent of With the autotransline voltage.

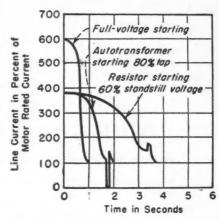
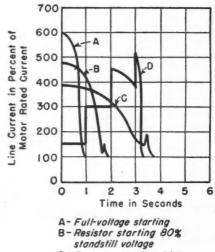


FIG. 8—Accelerating current of a squirrel cage motor driving a loaded centrifugal pump, autotransformer vs. resistor starting.



C- Resistor starting 65% standstill voltage
D- Resistor starting 4 point

D- Resistor starting 4 point increment type

FIG. 9—Accelerating current of a squirrel cage motor driving a loaded centrifugal pump, resistor starting vs. increment resistor starting.

former, the initial torque is 64 percent of the full voltage value, but with the resistor it is only 42 percent. However, the current drawn from the line is the same in both types of starting, but the autotransformer starter provides 50 percent more torque.

On some power systems, it is necessary to meet a restriction on the rate of current increase in starting. The rate of increase of current is determined to meet the conditions as they exist at the particular point on the system where the motor is to be started. For starting a motor on such a system, an "increment" type resistor starter is used with the results as shown on curve D of Fig. 9. In this case, current increments of 150 percent were permissible with one second intervals between, and three steps of resistance were necessary. At the end



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of the two seconds, the second accelerating contactor closes and the voltage of the motor has been increased to 75 percent of normal, where sufficient torque is available to start the load, as indicated by the decrease in current during the third second. The resistor is completely short-circuited at the end of three seconds, causing line voltage to be applied to the motor for normal operation. It is important, however, that the load applied to the power source be in small increments, so that the line voltage undergoes a minimum change.

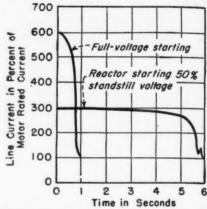
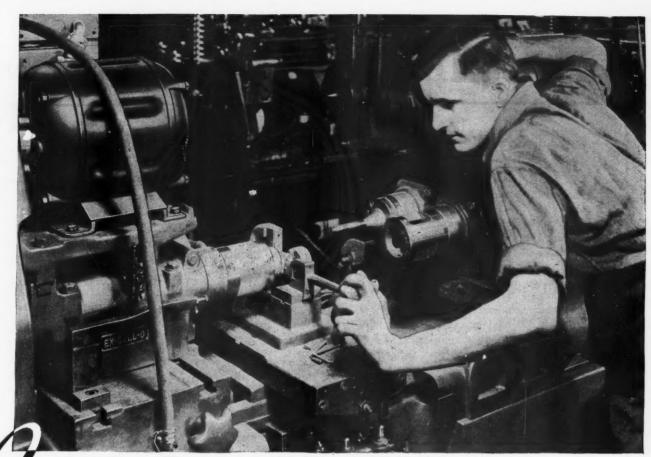


FIG. 10—Accelerating current of squirrel cage motor driving a loaded centrifugal pump, reactor starting vs. full voltgage starting.

A smooth start by means of a series reactor impressing 50 percent standstill voltage on the motor is shown The comparatively long in Fig. 10. accelerating time indicates a low value of accelerating torque, but the voltage at the motor terminals and the percentage of full-voltage torque gradually increase as full speed is approached, until the motor terminal voltage reaches almost normal value before the reactor is short circuited. A series resistor impressing only 50 percent standstill voltage on the motor would give the same initial inrush, but a current peak on short-circuiting the resistor higher than the initial peak. For this type of load, which has a rising speed-torque characteristic, a two-point reactor starter is definitely superior to a two-point resistor starter, but costs somewhat more.

It is evident from the foregoing that all methods of starting squirrel-cage induction motors have their advantages and disadvantages. The particular application involved will determine the type of starting that should be used. For those conditions where limited line capacity or abnormal motor-starting characteristics necessitate the use of current-reducing controllers, the other methods of starting are applied, depending on the particular application.



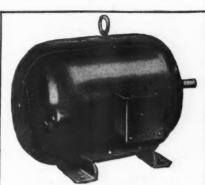
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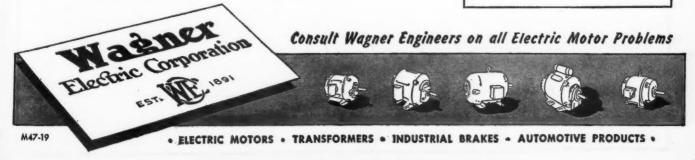
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H-5

How To Apply Oil-Immersion Heaters

LECTRIC HEATERS have been used for years for heating oil in both open tanks and closed pressure vessels. A wide variety of types and ratings of heaters can be used in most cases, with the exception that modifications to suit the particular oil must be made.

Since oil absorbs heat more slowly than water, oil-immersion heaters have twice as much heating surface as water-immersion heaters. This lower watt density is about 20 watts per square inch of heating surface—a conservative rating necessary to avoid a heavy encrustation of carbon on the heater sheath. The sheath material is generally steel, which better withstands higher temperatures incident to the use of oil, and also withstands the action of sulphur impurities if they are present. Let us consider some of the common uses of oil-immersion heaters.

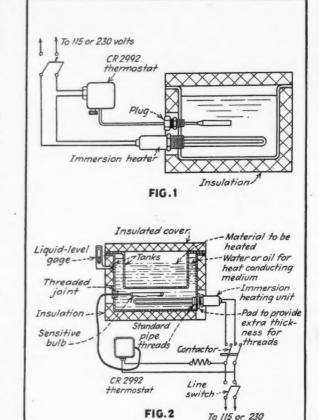
A small oil sterilizer or tempering bath can be made by using a "screw-in" immersion heater with any suitable container. However, it would be much better in temperature control and safety if made up as shown in Fig. 1. Or, if "over-the-side heaters are preferred, they can be used and installed in a similar manner.

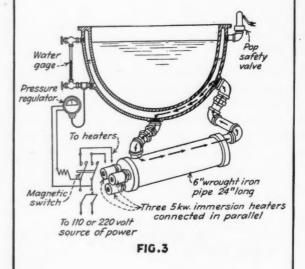
The double boiler scheme, shown in Fig. 2, permits temperatures up to 600 F without resorting to pressure in the jacket, if the jacket is filled with oil and if oil-immersion heaters are used. To heat a jacketed kettle (as shown in Fig. 3), or any other jacketed device, beyond the temperature corresponding to a safe steam pressure, hot oil is a practical method. Since pressure is not needed, an expansion tank can be used to keep the jackets full of oil in the same manner that expansion tanks are used on domestic hot-water systems. At times, the oil may need the help of a circulating pump to provide sufficiently swift heat transfer.

Another widespread application of immersion heaters is for preheating fuel oil. An installation generally consists of one or more heaters inserted into the pipeline from the storage tank to the burners, and so located as to deliver hot oil effectively at the burners. Thermostatic control and electrical interlocking with pump motors make operation safe.

In general, oil is a valuable medium for transferring heat rapidly to objects dipped in it, as in tempering baths, shrink pots, and sterilizers. It is also useful for heating jackets of tanks, kettles, and machines not built to stand pressure.

Oil-immersion heaters are available in many standard sizes and electrical ratings in both the "screw-in" and "over-the-side" types.





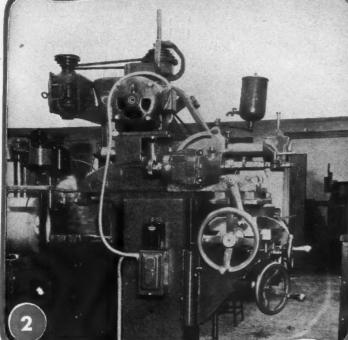
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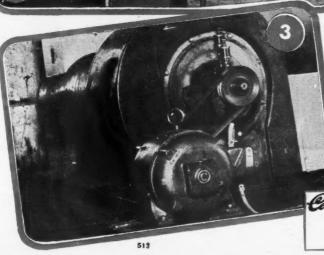
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Typical examples of the variety of applications are shown in the three photographs.

Illustration number 1 shows a Century 75 horsepower general purpose drip proof motor driving a coal pulverizer in a large industrial plant. The drip proof construction protects against falling objects or dripping liquids.

Number 2 shows a 1 horsepower Century open rated general purpose motor driving a milling machine in a tool room where extreme accuracy must be maintained. Protection isn't needed here because the motor is mounted on top of the machine—and in clean surroundings.

Number 3 shows a 11/2 horsepower Century totally enclosed motor driving a blower on a gas heated oven for paint drying.

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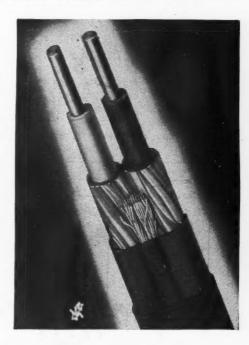
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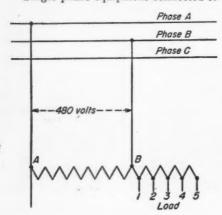
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Reader's Quiz

Detector Lamps

UESTION 243-We have two transformer banks that supply energy to our plant. One bank consists of three 500 kva. 7200/480 volt, 1 phase transformers connected delta-delta for three phase operation, and the second bank is composed of three 200 kva. 7200/240 volt transformers connected likewise. A set of neon ground detector lamps are connected to the 480 volt system and at times they glow intensely and voltage to ground is tested at 800 volts approximately when this condition occurs. All transformers and circuits have been thoroughly tested; however, this condition happens quite frequently. What could be the cause of this trouble? -G.A.D.

TO QUESTION 243—The voltage to ground on a 3 phase 480 volt system can be raised to 800 volts by equipment connected to the system as well as by the 7200/480 volt transformers which GAD says he has thoroughly checked. Single phase equipment connected to



the system such as a-c welding transformers or step up auto-transformers can raise the voltage between a phase wire and ground.

In the sketch, we have a step up auto-transformer with points A & B connected to phases A & B of a 3 phase system. The load connected

from A to points 1 to 5. If a ground occurred on the winding between point B & 5 the voltage to ground from phases B or C would be the product of the volts per turn of the transformer times the number of turns in circuit from A to the point of ground.

This same condition can exist on an adjustable tap primary coil of a welding transformer even though the welding transformer has a primary and secondary windings.—J.H.P.

To QUESTION 243—An intermittent inductive load is probably changing the inductive reactance of the 480 volt three phase system to be equal to the capacitive reactance of the neon lamps at the third harmonic; thus causing approximately 800 volts to exist across the neon lamps in each leg. This condition can be eliminated by replacing the neon lamps in each leg with four 110 volt incandescent lamps.

TO QUESTION 243-Delta-A delta connected and ungrounded three-phase transformers have their advantages but also have disadvantages which must be considered in designing such a system. In underground lines of moderate length and long overhead lines, the capacitive action may be so pronounced as to cause high frequency currents in the line and high voltages at certain points. Arcing grounds on the lines may result in equipment failure. The voltage strain to ground may rise to as high as 1.73 x normal line to ground strain when a conducting object comes in contact with any of the lines. This increase appears on the secondary side and at the ground detecting neon lamps causing them to glow at a voltage of 480 volts x 1.73 = 830 volts.

Grounding the midpoint of one of the single-phase transformers in the bank will supply a ground for the system. The potential of the two ends of the transformer grounded at its midpoint will be 240 volts while the potential of the other terminal will be 415 volts above ground.—R.G.C.

A TO QUESTION 243—Incorrect terminal voltage is usu-

ally easily detected. The motor is evidently wound for a standard three-phase supply.

Twice normal voltage momentarily applied will not injure the windings. Excessive starting torque, heat and hum indicate overvoltage. If the motor appears to run satisfactorily when carrying no load but rapidly loses speed and power when load is applied, it is obvious the voltage is too low, assuming of course the motor is in good condition.

After the proper voltage is determined, the no-load current can be compared with published lists, to give the approximate horsepower.

The true horsepower can be computed by prony brake test and the formula:

hp. =
$$\frac{6.28 \text{ x rpm x T}}{33,000}$$

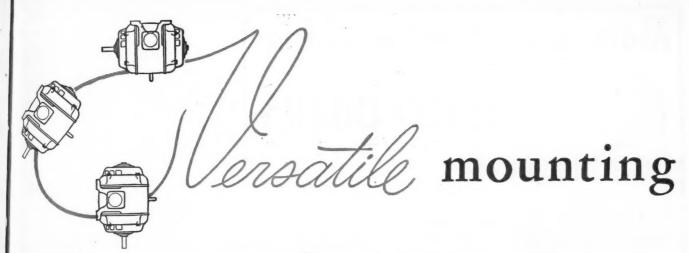
Where T is the torque in pounds—feet, obtained by multiplying the length of the brake arm in feet (measured from the center of the shaft) by the force exerted at the end of the lever arm in pounds.

A final temperature run should be made before the motor is put into service—T.B.B.

Thermostats

UESTION 244—Is there any way in which I can simply adjust thermostats (Bi-metallic type) that are used to protect fractional hp. motors and are mounted on the motors? The ones that I have seen use an adjusting screw which can be set to protect the motors at definite temperatures and I would like to know how I can set it for a particular temperature?—E.J.K.

A TO QUESTION 244—If you have a few of these bi-metallic type thermostats, you can build the oven at very little expense. The easy way is to get a piece of stove pipe from your neighborhood store, about 8" or 12" long with 2 pieces of 6"



There's no position in which the Fairbanks-Morse generalpurpose motor can't be mounted—and still retain its protective features.

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The bearing brackets can be turned to four positions 90° apart, to place the air vents where desired.

Bearings are suitable for both vertical and horizontal mounting.

The frame can be reversed to put the conduit box on either side.

This versatility is just one of many reasons why this motor is worth your investigation. Fairbanks, Morse & Co., Chicago 5, Illinois.

Every good feature you could ask!

Copperspun Rotor Centrifugally cast in one piece—and of copper.

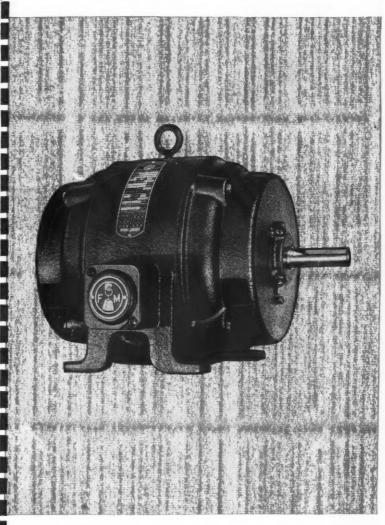
Protected Frame Excludes dripping liquids and falling particles.

Cross-flow Ventilation Provides uniform cooling—no hot spots.

Ball Bearings Sealed in and protected.

Recessed Conduit Box Permits neat installations in close quarters. Conventional box also provided.

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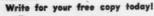
- · Visible, automatic lubrication
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- Minimum maintenance and repairs
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SUPERIOR CARBON PRODUCTS, INC.



x 6" x No. 16 gauge steel-one piece to be perforated and the other to serve as a roof or cover.

Place the perforated piece over a gas burner and stove pipe over it, Borrow a Centigrade scale thermometer and suspend the bulb end of the thermometer well within the oven, keeping the graduated scale above the roof so as to be readable.

Adjust your gas flame so that the heat within the oven can be kept on 40°C reading and leave set in position.

Remove your bi-metallic adjustable thermostat and place upon it a temporary pair of wires with a lamp of 25 watt capacity and apply 110 volt service to it, since the thermostat is cold. the test lamp will light knowing that the circuit is closed.

Now place the thermostat with the test leads connected and in circuit. within the oven, keeping it there until the circuit is opened by the heat within the oven, where the thermometer has shown to be only 40°C reading. Keeping everything in its present state, you remove the thermostat and adjust it after you have adjusted your gas flame to the desired higher Centigrade read-

A word of warning about setting your bi-metallic thermostat at a higher heat temperature is that your motors may be made to submit to overload, as most motors are of 40°C operation.-O.C.

TO QUESTION 244 - A • small electric oven in which the thermostat and an accurate bulb thermometer can be placed will serve the purpose for obtaining the temperature you desire for calibration. Trial adjustment of the calibrating screw will bring about the point of operation of the bi-metallic strip, that opens the thermostat, at the right temperature .-T.O.B.

Motor Generator Set

UESTION 245-I installed a 3 phase, 220 volt, 15 hp. motorgenerator set, changing a-c to d-c. This set has conventional system grounded as well as equipment grounded. What I would like to know is why d-c voltage never quite comes back as high as it was when set is shut down, sometimes for only a couple of minutes. D-c field rheostat's position remains the same.

For instance, I start m-g set. D-c voltage climbs to, say, 110 Leaving field rheostat alone, I shut down set. After voltage drops to zero, I start set up

LOOK TO WARE HI-LAG FUSE FOR PRODUCTION PROGRESS



The wide contact surface maintains low contact resistance.

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Spring tension on links locked into position, prevents loosening of contacts, which causes over heating.

Connections held firm by large arched spring steel washers and heavy bolts.



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End once and for all times the unnecessary delays—shut downs—interruptions and costly expense resulting from out-of-date fuses.

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The EFFICIENCY rack is constructed of

The EFFICIENCY rack is constructed of standard rolled steel channel—sizes according to size of bushings and number of mountings for each rack. Bushing supports are malleable iron. For A.C. service a brass half is furnished. Bushings are glazed porcelain, extra large and heavy.

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BRIEGEL METHOD TOOL CO. . Galva, III.

again (leaving rheostat alone). This time, d-c voltage will rise only to 100 volts. I shut down set, then start set up again, voltage will only rise to, say, 90 volts, and so on.

Is there anything wrong with this motor-generator set? Or hookup?—L.C.

TO QUESTION 245—The generator appears to be operating at lower than its designed voltage, that is, in the unstable portion of its magnetization curve. If it is a 220 volt generator run at 110 volts, the shunt field will be weak. The noload voltage will be very sensitive to changes in the residual magnetism which normally occur when the machine is started and stopped. The series field will help to maintain the voltage under load, but the regulation will be poor.

The remedy would be to rewind the present generator or substitute one having the proper normal voltage.—W.T.M.

A TO QUESTION 245—I shall attempt to answer this question, since I had the same problem recently.

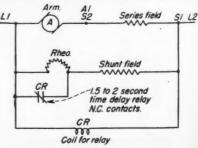
First, there is nothing wrong with the M-G set or the hook-up.

The reason for this condition is the fact that the M-G set is operating at lower voltage than it was originally designed for, therefore, the output of the generator will be less, and will be unable to overcome any added resistance completely, after being shut down.

The problem can be overcome by:

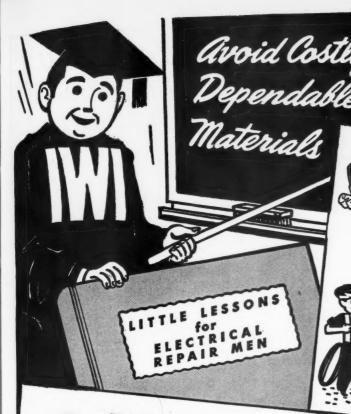
- Correcting the low voltage conditions.
- 2. Reducing the resistance in the rheostat momentarily, to allow the M-G to build up to full speed.
- 3. Use an over compounded generator with normal load connected at time of starting.

Since I could not correct the low



voltage condition, I adopted the 2nd suggestion as our solution.

I inserted a thermal time-delay relay in the circuit, thereby shorting out the rheostat for 1 to 2 seconds and allowing the generator to build up to full voltage output. At that time the



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Rylet Conduit Unions are available in a full range of standard sizes, male and female, and 90 degree male elbow types. Unions are available in two types—explosion-proof and general purpose. Reducing bushings are available in 46 sizes.

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The Pylet line also includes: Pipe Plugs, Fixture Pendant Loops and Hooks, Messenger Wire Conduit Support Clamps with and without fluorescent fixture hanger hooks.

Consult your Pylet Catalog for complete listings.

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THE PYLE-NATIONAL COMPANY
1344 N. Kostner Avenue, Chicago 51, Illinois

relay opened and allowed the rheostat to function at the predetermined position for output voltage. (See diagram).—J.M.F.

TO QUESTION 245—This is due to trouble in the d-c generator. Check the resistance to ground at 2 times generator voltage or over. See if the brushes are in the correct position, and working freely. Look for high resistance joints, or shorts in the fields and armature. Check if the fields are operating at a lower voltage than they were designed for. Sometimes the voltmeter is damaged.—H.S.

Can you ANSWER these QUESTIONS?

QUESTION H11—What would the maximum current per square inch be for a copper graphite brush? Out of what mixture in percentages of copper and graphite would one get the best results in commutation and maximum current per square inch?—E.J.K.

QUESTION J11—We have a 500 hp. 505 rpm., 2200 volt, 3 phase, 60 cycle wound-rotor motor on a rubber mill-line drive. The starter and secondary resistors are located in a control room, approximately 400 feet distant from the motor, including a vertical run of about 30 feet. The secondary conductors between motor and starter are 3-500 MCM in 3" conduit.

We have noted the secondary conductors slapping against the inside of the conduit in the vertical run with varying intensity, sometimes so hard as to cause concern over the possibility of damage to the insulation. What is the explanation for this? Is it customary to take precautions against this in installations of this type, or is it covered in the Code?—W.E.T.

QUESTION K11— What procedure is used in predetermining the increased losses due to increasing the length of the air gap on single and three-phase induction motors? Can these losses be compensated for in an eventual rewind?—T.B.B.

QUESTION L11 —How can I change a 12 volt Dodge generator to run on 110 volt a.c.? Kindny show diagrams.— E.P.R.

PLEASE SEND IN
YOUR ANSWERS BY JUNE 15

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PLANT

Type D₂F 3-Conductor

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NISA CONVENES IN

[FROM PAGE 70]

awarded to Wm. C. Bedoit, Chattanooga Armature Works, Chattanooga, Tenn., for his design of a punch and die press for making connectors to join the top and bottom layers of windings for bar wound rotors. For the design of a copper clip former, John R. Barham, Giles Armature and Electric Works, Marion, Illinois, copped the second prize of \$100. First prize winner Bedoit also captured the third award of \$50 for his design of a transformer lead indicator.

Based on a Sales Survey Report to the Board of Directors, the estimated total sales activities for motor repair shops for 1947 approximates \$130 million (repairs—\$57 million; new motor and controls—\$23 millions; other merchandise and contracts—\$50 millions). This volume is about 30 percent above the 1946 level.

Selden F. High, The Sullivan Electric Co., Cincinnati, was elected president at the annual business session. Joining him in the executive group are vice-president—R. E. Ward, Electric Motor and Repair Co., Raleigh, N. C.; treasurer—H. E. Grant Tennessee Electric Motor Service, Nashville; secretary—Wm. S. Giles, Giles Armature and Electric Works, Marion, Illinois. Fred B. Wipperman, St. Louis, was re-appointed executive secretary.

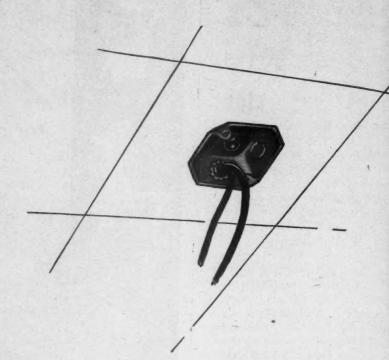
New directors previously elected for three year terms include: Wm. J. Wheeler (Region 1), J. Arthur Turner (Region 5), C. J. Cannon (Region 8), M. F. Zack (Region 11), and T. L. Rosenberg (Region 14).

By action of the Board of Directors, the 1948 convention will be held at the William Penn Hotel, Pittsburgh, Pa., the last week of April.



Clark Mesler (left), president of Purchase Electric Co., Grand Rapids, Mich., discusses motor windings and plans for a mass production small motor repair department with his shop superintendent Robert Rapa.





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Modern Lighting

Light Setting For Modern Motors

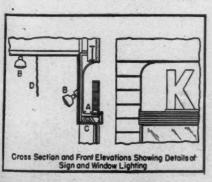
Modern trends in both lighting and automotive design are receiving twinbilled attention at the new Kaiser-Frazer showrooms in Newark, N. J. Motor Merchants, Incorporated, distributors for the new cars, are utilizing approved stage lighting techniques for illuminating their two display windows and have installed continuous fluorescent lines of light to effectively and efficiently light their main showroom, reception lounge, offices, service and used car departments.

Two 9 by 20-foot display windows flank a plate-glass entrance door centrally located in the 58-foot exterior frontage of dressed limestone. Above the glass, a continuous 12-inch band of brushed and ribbed aluminum extends across the entire front of the building while over the display windows the names of Kaiser and Frazer are spelled out with reinforced, 7-inch deep, free-standing letters set in recessed sign niches. Both recesses (each measuring 20 feet in length, 41 feet in height and 17 inches in depth) and all letters (3½ and 2½ feet in height) are faced with brushed aluminum. The signs are lighted by two continuous runs of argon-charged neon tubing located at the base and behind the letters and a single similarly-

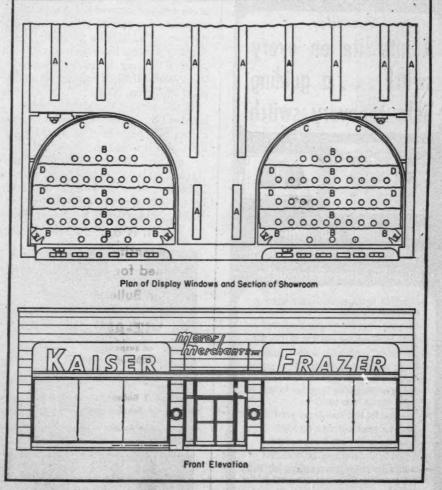
charged tube slightly in front and beneath the letters. Back lighting silhouettes the signs in strong silvergreen while front lighting throws a soft, shadow-relieving tint upwards towards the aluminum facings. Transformer cabinets are hidden in the niches behind the letters and step the service current of 120/208 volts up to the operating level of 12,000 volts. draped 19 feet behind the glass line.

Each display window is backed by a cycloramic flame-proofed curtain

Inside and above the upper limit of the glass, louvred and recessed toffers carry two rows of 40-watt, 3500 degree white fluorescent lamps, 4 lamps per row. Additional top lighting is provided by 36 PAR 150-watt incandescent lamps (in three rows of 10 units and one of 6) hidden behind series of suspended tormenter curtains. These lamps, a combination of reflector flood and spotlights, are individually controlled to provide the most effective illumination for the cars



Sign niches above the show windows Sign niches above the show windows contain large, aluminum-faced, free-standing letters naming the cars displayed. Two rows of argon-charged neon tubing behind the letters silhouette the signs in strong silver-green while a single row softly relieves front shadows. Above the windows, immediately inside the glass, two rows of fluorescents are recessed in louvred troffers. Focussing spots and floods troffers. Focussing spots and floods are hidden behind tormenter curtains.



Combinations of fluorescent and incandescent lamps are used to present Kaiser-Frazer products in an eye-appealing setting of stage-technique lighting. Show windows are top and side-lighted by PAR 150-watt incandescent lamps with a double row of fluorescents recessed across the top of the glass immediately inside. Showroom lighting is from Curtis Skylux fixtures that deliver average of 52 footcandles to the surfaces of displayed cars.



on display. Around the frame of each window, 11 additional 150-watt flood-lights are recessed in metal-lined troughs, three located across the top and four placed on either side at heights of 6 in., 2 ft., 7 ft. 6 in. and 9 ft. above the floor level. The resultant high intensity illumination provides a luxury setting for a luxury product, compells attention from passing pedestrians and effectively high-lights the streamlined beauty of the metal bodies.

The area immediately inside the main entrance flares into a 2400 square foot showroom having a ceiling height of 15 feet 10 inches. Curtis commercial twin Skylux fluorescent fixtures,

pendent mounted 18 inches below the ceiling and hung in eight continuous rows on 7 foot centers impose lines of light above the display area. A total of 160 lamps (40 watt, 3500 degree white) with a resultant consumption of 3.2 watts per square foot deliver 52 footcandles of illumination intensity to the cars on the floor. Skylux fixtures are also used to illuminate the two floors of office space located behind the showroom. Surface mounted on the 9 foot 6 inch ceilings as single luminaires or in combination runs of either two or three units, luminaires in these locations deliver intensities of light varying between 54 and 60 footcandles at desk level.

Improved Lighting in Textile Plant

There is no one universal solution to all industrial lighting problems. A close approach, of course, is a high level of well diffused light over the entire production area, which is satisfactory for lighting many industrial processes and activities. An excellent example of a special planned lighting solution to a lighting problem which might otherwise have been solved with general lighting is an installation in the Adams-Millis Corporation textile plant in Tryon, N. C.

In this plant it was desired to light a number of automatic spinning machines to a high level of well diffused light, which would enable the operators to quickly locate and tie broken threads. The important location to be lighted on these machines is the needle bars, while general lighting over the entire machine is also desirable. Keeping this in mind, the lighting problem

was approached directly. Individual fluorescent reflectors, each using two 40 watt lamps were installed end-to-end on Miller Company continuous wireway to form a continuous row of light. These rows of light were then mounted directly over the needle bars 7 ft. 6 in. above the floor.

Analysis of the lighting result reveals an illumination intensity of 75 footcandles at the needle bars, where most needed. Since the lighting unit is continuous, the light is well diffused and shadows are completely eliminated. Ample general illumination spreads over the back of the machines and into the work aisles from the diffuse type reflectors, even at the low mounting height of the units. Enough light is reflected from the machines and from the floor to the ceiling and upper side walls, which are painted white, to prevent a harsh contrast.



Miller continuous wireway fluorescent equipment located over needle bars of automatic spinning machines provides 75 footcandles on work plane at the Adams-Millis Corporation plant, Tryon, N. C.

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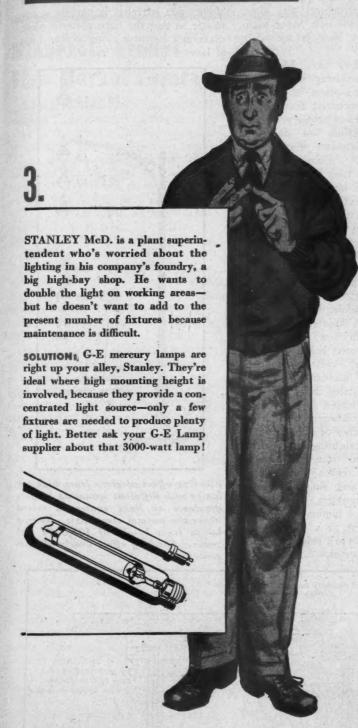
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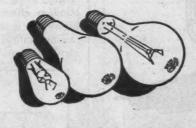
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MISS BETTY JANE L. is the charming secretary of an industrial purchasing agent. She knows the boss buys umpty-ump types of lamps for every department of the company—and that he hates to dicker with a dozen different suppliers to get the lamps be needs.

solution: You'll pave the way for that next raise, Betty Jane, if you remind the boss that he can buy every lamp he needs from one source—because General Electric makes 'em all—from standard G-E filament lamps to lamps for every specialized use. And he can be sure of quality, because General Electric Lamp research is constantly at work to make G-E lamps Stay Brighter Longer!



...G-E makes 'em all

G-E LAMPS
GENERAL & ELECTRIC

MULTI

INDUSTRIAL

LIGHTING

MODERN CONSTRUCTION REQUIRES MODERN LIGHTING



Lighting plans and patterns have taken a decided turn for modernization and contractors must be ready to supply the units that will give not only the best service but good appearance too. MULTI is the standby ... MULTI has the right unit for the need ... outdoor — Indoor — incandescent — fluorescent ... we have units for appearance, for quality, for PROFIT.

· Send for our complete catalog.

MULTI

ELECTRICAL MANUFACTURING CO. 4223 W. Lake St., CHICAGO 24, ILL.

Underpass Luminaires

Two types of luminaires and two methods of mounting maintain high intensities of pavement illumination beneath bridge structures and along open sections of the new super highways designed by New Jersey safety engineers.

Highway bridges have been constructed at all roadway intersections to eliminate cross-lane traffic and luminaires are mounted between the supporting girders of bridge structures so that illumination on underpass pavement approximates that on the highway. Luminaires are mounted directly over the center lines of lower traffic lanes and two-way distribution directs beams of light in opposite directions along the roadways parallel to curb lines. Luminaires are protected against damage from truck-borne cargo by so mounting the units that bottoms of globes are kept above the lowest elevation of concrete-encased girders. Bridge facia beams protect luminaires from being struck by cargo approaching in the direction of traffic flow. Facia beams also serve to protect the eyes of motorists from unshielded light sources. Wiring between luminaires and transformer pits is carried in 11-inch rigid steel conduit encased in the paving slabs of upper roadways.

On open stretches of roadway, staggered spacing of lighting units is used, with double-arm standards erected along the raised center island between express lanes, and single-arm units erected along shoulders. The relative blinding effect of luminaires on open highways is kept at a minimum by raising luminaires to a height of 25 feet above the pavement. As illustrated,

blinding effect decreases parabolically as mounting heights are increased, the relative amount with units at 25 feet being only 11 percent that of units mounted at 10 feet heights. With units mounted near the outer edges of lanes, distribution of light along open stretches is narrow asymmetric so that the light patterns place maximum lighting along center lines of lanes.

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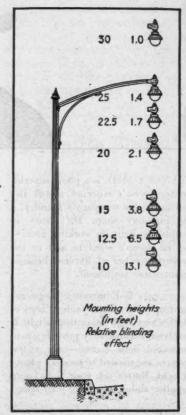
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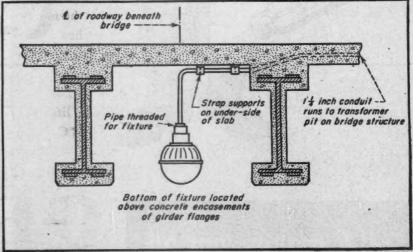
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Blinding effect of glare from highway lamps with different mounting heights decreases as light source is raised above the normal visual axis. Raising lamps from height of 10 to 25 feet reduces blinding effect nearly 90 percent.



Luminaires under highway bridges are mounted between girders with globes raised above the lowest point of concrete encasements. Conduit runs between luminaires and transformer pits are 1½-inch rigid steel, encased in concrete paving slabs of upper roadways.

In the News

Minnesota Groups View Market Future

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> A bright future awaits the electrical industry. However, it's going to take some of that good old fashioned work, progressive sales and service techniques, sensible pricing policies and a lot more consideration of the "customer" if everyone is to get his share of the tremendous business volume industry leaders are predicting. That was the general trend of thinking at the *Electrical Trade Convention of some 15 electrical organizations held at Duluth, Minn., March 16-18. Co-ordinated through the North Central Electrical Industries, the conference brought together some 500 representatives of all branches of Minnesota's electrical industry.

> General subjects of common interest were presented at all-industry sessions. The need for devising promotional and sales techniques to meet the bottled gas competition in the cooking and water heater fields was discussed by A. H. Jaeger, Hotpoint, Inc., Chicago; and Clark M. Osterheld, McGraw Electric Company.

Although the largest market for adequate wiring lies in electrical moderpization of existing homes, immediate promotional efforts are being concentrated on the new housing program, stated Ed Northrup, National Adequate Wiring Bureau, New York. With FHA including adequate wiring in their loan approvals and financial institutions promoting its acceptance, the time is ripe for the electrical industry to get busy, he added.

There will be no serious recession in the radio and appliance industry this year predicted Willard Johannsen, editor, Electrical Dealer, who sees about a 50 percent increase in business over last year. With double the prewar industry capacity to produce; with sheet and strip steel demand and supply about to meet by the end of this year; and with blue chip companies coming into the appliance manufacturing field, the competitive battle is not far off, he warned. Appliance prices have about reached their peak and will follow an orderly decline, he added, cautioning that the real test of survival will come only after the appearance of a real buyer's market.

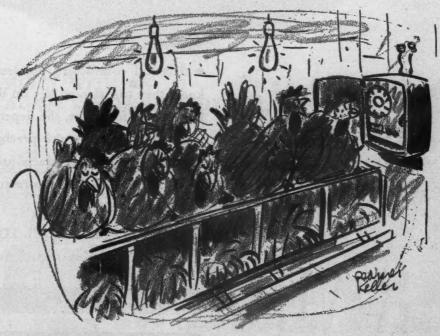
To survive in the expected buyer's market, the appliance dealer must determine to do a good selling job backed by adequate staff and service facilities, asserted George Jensen, district manager, Nash-Kelvinator Corp. Concentrate on a single line of appliances in each category and an allelectric service policy to permit better promotional and selling activity, he advised.

Development and acceptance of an "all-electric" philosophy and promotion of complete electrification can hold the front line of the electrical industry. Spotting some of the present weak points, C. M. Baldwin, Minnesota Power and Light Company, revealed that only twelve of some 160 appliance dealers surveyed could offer complete electrical service; only eight handled electrical merchandise exclusively. Noting that in some cases, installation of electric ranges and water heaters exceed the wholesale price of the appliance, he urged reduction of this cost and concentration on efficient wiring of America's homesonly one in ten at present having adequate wiring.

The electrical contractor-dealer is in the enviable industry position of being able to offer a complete electrical

service-sales, installation and maintenance, asserted Wm. A. Ritt, secretary-manager, Minnesota Electrical Council, Inc., Minneapolis. That he is doing an effective job in holding our front line is evidenced by a recent survey the Council made of its membership. Detailed reports from 31 percent of 535 members were sufficiently representative that they could be projected for the entire group. Ritt's figures indicated that the average Minnesota electrical contractordealer sold \$31,655.04 worth of electrical equipment in 1946 (68 percentwiring, lighting and motors; 32 percent-radio and appliance sales). Those operating strictly as contractors sold \$32,434.59 worth of electrical equipment (estimated total including labor-\$47,025.86). Excluded were reports from large Twin-Cities firms, since such inclusion would not present a true picture of the average operator.

To fortify and maintain this front line of the industry, Ritt urged: (1) contractor-dealers to improve their standards of public service at economical levels; (2) wholesalers to develop new and more effective means of supplying the contractor-dealer with superior merchandise at prices to meet competition; (3) manufacturers to



"I wish you had watched when that electrician was showing how to set that timer. This getting up at four every morning is killing me."



SEND FOR FREE COMPLETE CATALOG ON RACO PRODUCTS • Electrical contractors, builders, and architects the country over know they can always rely on Raco. They know it's the packaged line, the uniform line, the dependable line—that it's backed by 34 years' experience in the precision fabrication of steel products. Furthermore, Raco products are listed by Underwriter's Laboratories. Write today for information on this complete line of switch and outlet boxes.

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establish better selling, servicing and distribution programs; and (4) utilities to lend their maximum support to a sound program for electrical development. He urged the cooperation of all industry branches to offset the "by pass the contractor-dealer" promotional activities of the mass merchandisers.

Presenting an insight into today's challenge to the lighting industry, L. B. Paist, pinch hitting for C. T. Bremicker, Northern States Power Company, cited the progress made over the past 20 years. A customer can now buy four times the 1926 lighting values (10 footcandles) for the 1926 cost, or a 50 footcandle installation for less than a 25 percent increase over the 1926 cost, he asserted. Today the 50 footcandle fluorescent troffer job costs \$44.39 per footcandle year, compared with \$179.76 per footcandle year for the 10 footcandle incandescent job in 1926, he added. The job ahead is to sell more of the product (higher intensities) plus comfortable, glare-free, soundly planned lighting systems to permit the customer to get the real benefit of those higher intensities, he concluded.

We are in dire need of highway lighting asserted Carl F. Jensen, Westinghouse Lamp Division, Chicago, pointing out that the U. S. can show only 1,000 miles of illuminated highway. Insurance statistics show most traffic accidents and fatalities occur in the rural areas. Darkness accounts for 65 percent of the accidents and 75 percent of the deaths.

Manufacturers are constantly directing research to improve the quality of lighting fixtures, stated Harris Reinhart, Sylvania Electric Products Co. With brightness control becoming increasingly important in modern lighting design, engineers are focusing attention on proper direction, diffusion, distribution and color as well as adequate illumination levels, he added.

Rural electrification problems were the subject of an entire afternoon session. The need for more adequate ventilation to reduce condensation and ice formation on the walls of modern (concrete and steel) farm buildings, was outlined by R. B. Aakre. agricultural engineer, North Central School and Station, Grand Rapids. Discussing the sale of electric service and equipment to farm families, Miss Bess Rowe, The Farmer, St. Paul, offered the thought-provoking suggestion of recommending two small electric ranges instead of one large super deluxe type to the farm wife. Such a move would provide the double burner and oven capacity frequently necessary to cook for large farm families, she asserted.





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MANAICH Renewable Fuses

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Sold by Leading Wholesalers Everywhere





Good appearance means a lot in electrical installations these days... reflects the true craftsmanship and thoroughness of the contractor and his men on the job.

Alert to the importance of a "finished look" in every installation, Miller Electric Company, Jacksonville, Florida, says this, "Even disregarding labor and materials saved through use of a GREENLEE Bender it quickly pays for itself through the 'superior workmanship' appearance it helps give the job.

"For example, when a bank of conduits makes a bend, we find it advantageous to use a GREENLEE Bender so that the radius of each conduit can be

changed to form a smooth, even sweep of all conduits in that bank."

And, in addition to this great plus benefit the GREENLEE gives your work, you enjoy big labor and materials savings.

Many contractors report savings of 50% to 70% on labor alone. For the GREENLEE is one-man-operated. Makes smooth, accurate bends in but a few minutes...in pipe up to 4½", rigid and

thin-wall conduit, tubing, bus-bars.Get complete facts today. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1745 Columbia Ave., Rockford, Illinois.





OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK
Hand Benders . Joist Borers . Cable Pullers . Radio Chassis Punches . Pipe Pushers



New president of the Minnesota Electrical Council, Inc., W. Arthur Starbird (right), Starbird Electric Company, Minneapolis, receives well wishes of retiring president Eric G. Nylund, Duluth, at recent meeting of that group in Duluth.

Pulling no punches, Glenn Rowell, engineer for the Fire Underwriters Inspection Bureau. Minneapolis, pointed out industry failings in the rural market. The contractor must not permit farmers to tell him how to wire their farms and how much it should cost, he asserted. Unless inadequate wiring on existing farms is corrected, fires will increase, he warned, stressing the need for a real reinspection program. Biggest danger lies in the partial short circuit not heavy enough to blow fuses, he added. Improper electrical equipment offered for rural installation poses another problem in Rowell's estimation. Although manufacturers have given some cooperation, it is far from enough, he revealed, adding that the latest development in this respect is the recent Underwriters Laboratories approval of some types of aluminum outlet boxes for farm wiring use.

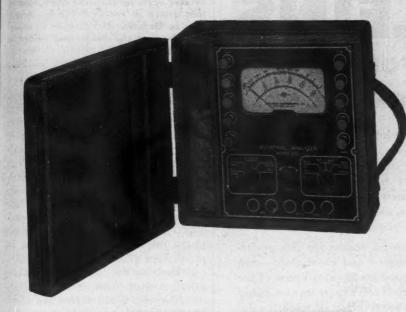
Germicidal lamps are finding increased use in farm buildings, according to J. V. Gaynor, Mitchell Mfg. Co. Available at present are 4, 8, 15 and 30 watt tubes that kill all airborne bacteria, he asserted. As to future market, Gaynor predicted that within three years germicidal lamp and fixture sales will top any electrical appliance sales except the major items.

A backlog of 40 million motors is on the industry books today, stated J. L. Fitch, manager WESCO, St. Paul. Westinghouse motor production capacity is 2½ times prewar, and their small motor capacity is 340 percent of 1940 average, he revealed. Although their total production is only one-third of expected volume, this is greater than any year prior to 1941. January 1947 production was eight times that of

NOW AVAILABLE FOR IMMEDIATE SHIPMENT!

The New Model 630

INDUSTRIAL ANALYZER



SPECIFICATIONS:

- 6 A.C. VOLTAGE RANGES: 0 to 75/150/300/750/1,500/3,000 Volts.
- 6 A.C. VOLTAGE RANGES: 0 to 75/150/300/750/1,500/3,000 Volts.
- 4 A. C. CURRENT RANGES: 0 to 3/7.5/15/30 Amperes.
- 4 D.C. CURRENT RANGES: 0 to 3/7.5/15/30 Amperes.
- 3 RESISTANCE RANGES:

 LOW RESISTANCE RANGE 0 to 10,000

 Ohms (40 Ohms appears in the center of this scale. First division is one ohm.)

 MEDIUM RESISTANCE RANGE 0 to 100,000 Ohms.

HIGH RESISTANCE RANGE - 0 to 1 Megohm.

MEASURES:

A.C. VOLTS UP TO 3,000 VOLTS (IN 6 RANGES)

3,000 VOLTS (IN 6 RANGES)

A.C. CURRENTS UP TO

30 AMPERES (IN 4 RANGES)

D.C. CURRENTS UP TO 30 AMPERES (IN 4 RANGES)

RESISTANCE UP TO

I MEGOHM (IN 3 RANGES)

A single scale is used for making all voltage measurements — both A.C. and D.C. Unique circuit design results in close-to-perfect linear scale with no variation between A.C. and D.C. measurements, thus permitting the one scale to be used for all twelve voltage ranges.

The sew Model 630 provides all the measuring services required for maintenance, development, testing and repair work. Latest of a long line of instruments specifically designed to meet the requirements of electrical contractors for a unit which will provide a means of accurately making the three basic electrical measurements — VOLTS, OHMS AND AMPERES, the Model 630 includes many of the technical advances and improvements made in War Production. The Model 630 operates on a self-contained standard battery and is therefore always for use. No external source of current is required.

Model 630 comes housed in a hand-rubbed Oak cabinet complete with cover, self-contained battery, test leads and instructions. Size 9" x 10" x 5".

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Harold Cooper, president, Minnesota Electrical Inspectors Association addresses open forum code discussion of that group at recent N.C.E.I. convention in Duluth. Mr. Cooper is superintendent of the municipal utility at Waseca, Minnesota.

June of last year, he added.

Rapid expansion of the Minnesota Electrical Council, Inc., was reported by secretary-manager Wm. A. Ritt at the Fifteenth Annual Meeting of that group. Membership now stands at 535 (a 37 percent increase over last year) and groups from other states within the Council trade area are seeking affiliation, he stated. Discussing potential appliance sales volume, Ritt told members they could gauge their specific area volume on the basis of \$72 per meter per year.

Addressing the above policy-making group, August Eckel, middle west editor. Electrical Construction and Maintenance predicted a billion dollar electrical construction market in 1947 involving some 26 million man-hours of skilled labor. With the material situation easing somewhat and the possibility of ample supplies by mid year, skilled labor may well become the 1947 construction bottleneck, Eckel asserted. IBEW estimates that its 110,000 members and 13,000 apprentices can handle about a 12 billion dollar over-all construction program, he added, but would fall short if the predicted 16 to 22 billion dollar program were to materialize. Citing the rural contractors plight, many of whom had to pass up numerous complete farm wiring jobs due to lack of competent help, Eckel placed the responsibility on the doorstep of the contracting industry and commended the Council on its sponsorship of legislation recently passed that amends the Minnesota State Licensing Law to permit the establishment of a temporary Class B Master and Journeyman Electrician classification specifically for farm and residential wiring.

By unanimous vote of those present,

the Council adopted resolutions: (1) Requesting Congress to suspend the four cent per pound import duty on copper as an emergency measure to holster domestic supply; (2) Requesting supplier to discontinue recent practices of raising prices to contractors by eliminating or reducing trade discounts; (3) Urging suppliers to return to prewar practice of quoting firm prices on electrical materials so contractor can give firm prices on electrical work; and (4) Endorsing proposals now before the Minnesota State Legislature to establish a State Department of Business to aid in development of business, assist business generally, and promote enforcement of fair trading laws.

Elected at the annual Council Board of Directors meeting were the following officers: President—W. Arthur Starbird, Minneapolis; vice-president—E. W. Linner, Stillwater; secretary—Wm. A. Ritt, St. Peter; and treasurer—F. M. Tripp, Minneapolis. Chosen as directors-at-large on the Council Board were: C. D. Burton, Brainerd; Don Kehne, St. Paul; M. A. Oein, Cloquet; E. W. Linner, Stillwater; George R. Jones, Minneapolis; Louis H. Gordon, Albert Lea; Paul Schorr, Sr., St. Paul; and L. E.

Schaffer, Pipestone.

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At the business session, Moreau Bailey, Albert Lea was elected president of the Association. Other officers include: vice-president-G. L. "Happy" Haugland, Appleton, Minn.; secretary-treasurer-Wm. A. Ritt, St. Peter; field representative—Earl Anderson. Elected to the Board of Directors for a three year term were: C. D. Burton, Brainerd; E. R. Danielson, Thief River Falls; Ed Karst, Fergus Falls; and L. A. McClure, Luverne to complete Haugland's term. Representing the Association of the Board of Directors of the Minnesota Electrical Council are: Sam Newstone (Western Minn.); John Ellenbecker (Central Minn.); E. G. Nylund (North East Minn.); Ed Karst (North West Minn.), and Wm. A. Ritt (Southern Minn.).

Larry Davis Named Secretary of NEBB

Laurence W. Davis has been appointed Executive Secretary of the National Electrical Benefit Board. The National Electrical Benefit Board determines policy and administers the pension fund for union employees of the electrical contracting industry.

Mr. Davis assumes the new post after 27 years with the National Elec-



A step-by-step guide for planning a complete, modern electrical wiring system for farms... a system that will provide for present needs, as well as for future expansion.

Here's what an official of the U. S. Department of Agriculture says:

"We wish to take this opportunity to congratulate you on having issued a very fine booklet that should be of real assistance to wiring contractors and inspectors, as well as others engaged in activities

pertaining to farmstead wiring.

"Frankly, the booklet can be used very nicely in connection with the new code requirements by contractors who are just now getting into the field of farmstead wiring installations. Your new booklet explains how to go about planning for farmstead wiring in a manner that should be highly acceptable to contractors and wiring inspectors."

Westinghouse Electric Corporation • Pittsburgh, Pa.

PRICE	250	each
(1 to	100 CO	PIES)
Send f	or your	copy
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You'll fi	nd it inv	alvable

in planning any farm

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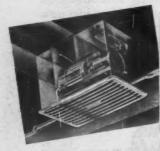


AS a result of Clipper Blower consumer advertising more than 20,000 housewives asked about the Clipper last year. This can mean real business

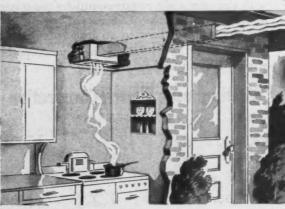
These patented small room ventilators are specially designed for kitchens, bathrooms, dens ... as well as for ticket booths, X-ray rooms, toilets, clinics-in fact any small room. They are mounted in the ceiling between joists and vented outsidethey trap and expel unwanted air, heat and odors the instant they rise.

Unlike any other equipment, the Clipper Blower is a complete packaged ventilator in which the motor is entirely removed from the air streamaway from all contaminated air. This means greater efficiency, longer life and easier servicing.

Ask your jobber for details of the Clipper Sales Plan or write us for complete information.



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FRADE-WIND MOTORFANS, INC. 5709 SOUTH MAIN ST., LOS ANGELES 37, CALIF.



L. W. DAVIS

trical Contractors Association, which with the International Brotherhood of Electrical Workers, recently concluded the Employees Benefit Agreement under which the pension system is provided. He was released as General Manager of NECA to conduct the duties of the new office. Mr. Davis, however, continues to be Treasurer of

The first industry-wide pension plan in the Construction Industry where employees are intermittent, the Employees Benefit Agreement provides for employer contributions to augment on a dollar-for-dollar matching basis the payments of individual workers into the IBEW Pension Fund. The employer contribution is provided through a 1 percent payroll assessment. This will enable payment of \$50 a month retirement benefits to members of the IBEW who reach the age of 65 years after 20 years continuous membership in the union. The payroll assessments commence on May 5.

Supervising and adminstering the benefit fund is the NEBB which is composed of seven representatives of the IBEW and seven of NECA with one public member, Dr. Edwin E. Witte of the University of Wisconsin, appointed by the Secretary of Labor.

Mr. Davis will be in charge of setting up collection and accounting systems and records for the fund. This involves establishment of local benefit boards in each area served by a NECA Chapter.

Wiring Devices

Approximately 30,000 tons of steel will be channeled into production of electrical outlets, switch boxes and



FOR PLANNED LIGHTING

The Constellation offers the ultimate in planned lighting installations. Made in both two-light and four-light, 40 Watt units, it can fulfill any commercial lighting need. Single units or continuous runs can be installed at ceiling surface or from attractive, adjustable hangers. Comfortable fluorescent light flows through bent, ceramic-treated glass panels or rigid, baked enameled louvres. The Constellation meets the requirements of the Utilities Research Laboratories.

Sold nationally through leading electrical wholesalers.

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BRIGHTER FUTURE

for night sports

Here is floodlighting at its best! Improved designs give you the most advanced features in floodlighting equipment. Mechanical simplicity makes for easier wiring... easier installation... and easier servicing. And ever-dependable Goodrich quality gives you the best possible protection for your investment.

Shown are two of the many popular floodlights in the extensive Goodrich line... with cast aluminum mountings and permanent porcelain enamel finish. If you have a problem in outdoor illumination, take advantage of Goodrich knowledge and experience. Goodrich engineers will gladly help you with technical information, layouts and recommendations for your specific job. Write us.



Sold Through Electrical Wholesalers

GOODRICH ELECTRIC COMPANY 4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS



Wm. A. Ritt, secretary-manager, Minnesota Electrical Council, Inc., presents results of statewide survey of membership showing annual sales volume of electrical contractors ouside Twin-Cities area. Data was released at an all-industry session of the North Central Electrical Industries at Duluth convention.

fittings during each of the last three quarters of 1947. About the same amount of steel was allocated by Civilian Production Administration for electrical wiring devices during the same periods of 1946, but this year's allocations have been set by voluntary agreements.

Needs of the industry were disclosed at a recent conference of wiring device manufacturers and CPA officials in Washington. CPA estimated 1947 requirements at 161,000,000 outlet, switch and receptacle boxes, and 207,000,000 BX and Romex box connectors. These figures do not include estimated deficits in 1946 of 24,-000,000 boxes and 49,000,000 connectors. Most of the existing and future demands are for housing, including maintenance in existing housing, rural electrification and non-deferrable essential commercial and industrial construction.

Wiring industry representatives at the conference included Claude E. Bowers, Bowers Manufacturing Co.; R. D. Cook, Steel City Electric Co.; H. E. Kaden, Newart Manufacturing Co.; N. J. MacDonald, Thomas & Betts Co.; F. R. McQuown, All-Steel Equipment Co.; G. H. Keith Miller, Rattan Manufacturing Co.; D. J. Murray, General Electric Co.; William Parker, Union Insulating Co.; F. E. Pope, Porcelain Products Co.; W. C. Robinson, Jr., National Electric Products Co.; and Murray Whitfield, Appleton Electric Co.



Illustrated: Electromode Suspension Type Unit Heater.

HERE'S THE SAFE ANSWER TO AUXILIARY HEATING NEEDS

You can talk economy as well as safety when you handle Electromode All-Electric Heaters.

Factory men like Electromodes because they require no plumbing connections and can be installed wherever circuit wires can be run. Another selling point: Electromodes cut costs of overtime periods and days when only certain departments are working, by saving the expense of operating the main heating plant.

Best of all, Electromodes are completely

safe, thanks to the exclusive Safety-Grid Heating Element that eliminates all danger of fire, shock or explosion. This element has no exposed hot wires or glowing coils.

There are Electromode unit heaters for every industrial purpose—made in capacities from 1.5 to 60 KW—also portable and built-in-wall heaters for home and office. All are approved by Underwriters' Laboratories. We invite electrical contractors to write for further information.

Send for Bulletin 45-U and Heating Analysis Form, Address Dept, EC-57.



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Combination Portable or Suspension Heater. May be plugged in wherever heat is needed. Capacities: 1.5 to 7.5 KW.



Truck Type Heater—one of many specialized heating units designed by Electromode. Capacities: 3, 6, 10 and 12 KW.



WORLD'S LEADING EXCLUSIVE MANUFACTURER OF ALL-ELECTRIC HEATERS . ELECTROMODE CORPORATION, 45 Crouch St., Rochester 3, N.Y.

Mercury-Lighting

COSTS GO DOWN WITH





TULAMP TRANSFORMERS

The "more light per dollar" advantage you get from G-E mercury-vapor lighting is even greater when you specify General Electric Tulamp transformers for your installations. Costs come down initially when you select the compact Tulamp transformer. Installation is simplified—only half as many transformers are needed for a given number of lamps. Less wiring material is required, and more effective fuse protection is possible because of low starting and operating current. Operating costs are reduced through smaller transformer losses inherent in the Tulamp design.

HIGH POWER-FACTOR TOO

General Electric Tulamp transformers are high-power-factor units, accurately designed to assure successful operation. Strong internal framework holds the core, coil, and housing firmly together, minimizing noise from vibration. Core surfaces are amply exposed to dissipate heat, prolonging transformer life. Large and roomy junction box, plus nine standard knockouts facilitate installation.

When you specify General Electric Mercury H lamps and G-E transformers, you get *co-ordinated design—lamps and transformers built to work together. For further information, write Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



Housing Expediter Controls CPA

Expiration March 31 of the Second War Powers Act, under which the government exercised some 700 controls over industry, bore little significance either to electric utilities or to manufacturers of electrical equipment.

Already operating under sweeping legislative authority, the Office of the Housing Expediter quietly took over from Civilian Production Administration the allocation of scarce building materials and controls over residential and commercial construction. In this respect, OHE merely assumed the authority it had delegated to CPA to channel materials into housing.

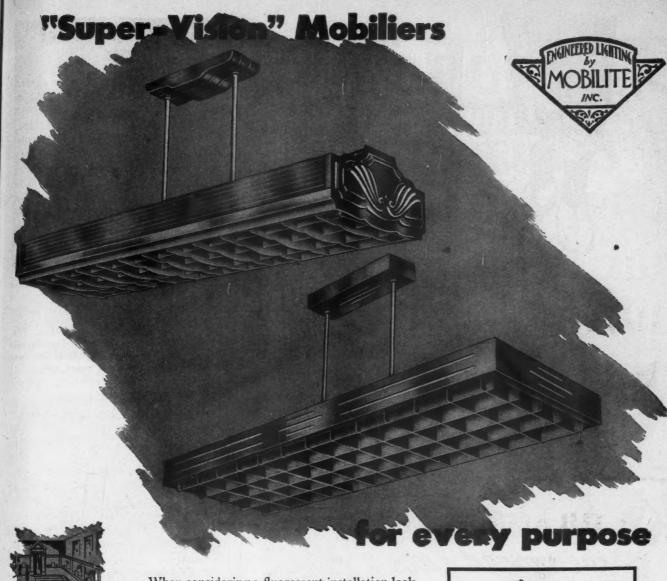
Last-hour legislation enacted by the Congress maintained the allocation programs for tin and antimony, and inventory controls on rubber. CPA's controls over uranium source materials already had been taken over by the Atomic Energy Commission.

OHE already has adopted the framework of controls over housing materials exercised by CPA under PR-28. It has announced, however, that it will not set priority ratings for steel, resins or other materials "unless an emergency develops." It will continue priority authorizations for pig iron to be used in producing soil pipe. Construction limitations also are unchanged.

CPA, which did not die despite the



Abe Sluis (right) gets "shot" by his customer, upon completion of a wiring job in a photographic studio. Abe is an electrical contractor in the Roseland district of Chicago's south side. Adam Sluis (left) is just out of bell bottom trousers (Navy). The big fellow in center is Jannes Krist.



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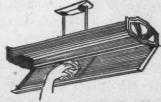
STORES

SCHOOLS

When considering a fluorescent installation look to Mobilite. The entire line of "Super-Vision" Mobiliers is constructed to give trouble-free service and designed to complement interiors. "Super-Vision" Mobiliers are available in types for every requirement . . . for offices, stores, smartly decorated salons, banks, schools, institutions. Ideal for high or low ceilings or under balconies. Standard attachments readily convert single units to a continuous run, flush or suspension, single or double stem. All the elements of modern design, highest efficiency, minimum maintenance, functional flexibility and superior craftsmanship have been incorporated in these high quality fluorescent units. Yes, look to Mobilite for your guarantee of the finest in fluorescent fixtures.

Write for Catalog J





Slight pressure on spring button re-lease at ends of unit permits ample opening for servicing, relamping and cleaning.

MOBILITE, INC.

Manufacturers of Fluorescent Lighting JERSEY CITY 6, NEW JERSEY

ELECTRICAL CONSTRUCTION AND MAINTENANCE . . : MAY, 1947



a NEW and LARGER PLANT

Since 1898



Fluorescent ceiling fixtures • Showcase, wall case and window lighting • Adda-Strip • and other products.

100% increase in plant facilities . . . all departments together again under one roof . . . no more production jams because of crowded conditions! Now, with more men, more space and more equipment than ever before, we are stepping up production to keep pace with your demands for GARCY products. Let's go, customers. We are all set to serve you.

GARDEN CITY PLTG. & MFG. CO.

1750 North Ashland Avenue, Chicago 22, Illinois



Moreau Baily (left), Albert Lea, takes over as president of the Minnesota Electrical Association at Duluth convention under watchful eye of former president M. A. "Curley" Oien, Cloquet. Bailey's father, Charles, was one of eight men who founded the state association some 20 years ago.

passing of most of its war powers, will continue to administer tin and antimony allocations until June 30. Congress also extended the agency's domestic controls over natural and synthetic rubber for one year, during which time the legislators are expected to formulate a national policy for maintenance of synthetic production. Imports of rubber will no longer be controlled, but processors still cannot build up stockpiles exceeding their needs for 60 days. The Government has gone out of business as an importer of natural rubber.

Officers Elected For NECA Coast Chapter

New by-laws were adopted and new officers elected at the annual meeting of the Northern California Chapter, National Electrical Contractors Association, held in Oakland recently.

Re-elected as president was Dan Bronson, California Electric Co., Ltd., Oakland; vice president is Lee Bannister of Richmond. Ed Buttner, Scott-Buttner Electric Co., was reelected governor and William A. Cyr, honorary member, was reappointed treasurer.

To administer the affairs of the Chapter between quarterly meetings of the Board of Directors, which is appointed from each of the branches in proportion to membership, an administrative committee was authorized consisting of the officers and the chairman of the branch organizations.



Change BOXES without disturbing Conduit!

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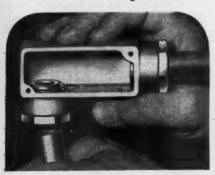
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Change CONDUIT

Use Thin-Wall with same boxes!

Only Kondu gives you these time-saving features. Every Kondu fitting is a union—and takes any kind of conduit, at any outlet. Kondu fittings hold permanently tight . . . vibration-proof.

Practically unbreakable.

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KONDU CORPORATION Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario



SORGE TRANSFORMERS

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Firm Prices

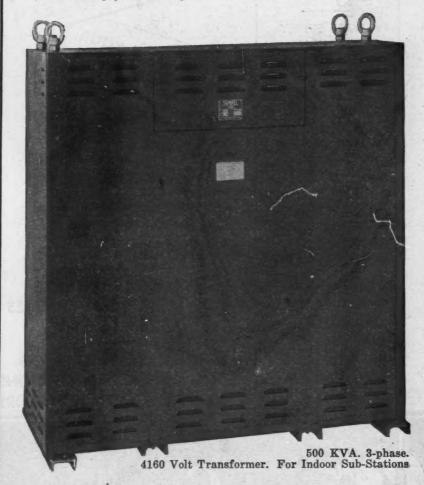
Without escalator clause.
10-day price protection on all quotations.

Definite Deliveries

We may not always be able to ship at once, but you can depend on the delivery promise given.



1/4 KVA. Single Phase 460/230 to 115 volt.



SORGEL ELECTRIC CO., 836 W. NATIONAL AVE., MILWAUKEE 4, WISCONSIN Ploneers in the development and manufacturing of Air-Cooled Transformers

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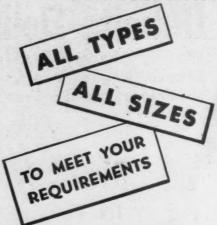
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REPAIR SHOPS...NOTE

A FACTOR OF PARAMOUNT IMPORTANCE WHEN PROMPT SERVICE IS ESSENTIAL



FOR PROMPT SERVICE
CONTACT YOUR NEAREST
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SEND IN OLD CORES OF BOLT OR NUT TYPE CONSTRUCTION FOR REFILL

SPECIAL SIZES CAN BE MADE FROM YOUR SAMPLES OR SKETCHES

SEND FOR OUR CATALOG LISTING COMPLETE DIMENSIONS OF ALL TYPES OF COMMUTATORS



Pioneers of the electrical contracting industry are: (L to R) Henry B. "Dad" Klein, Klein Electric Co., Winona, Minn., who has 60 years to his credit and E. W. Linner, Linner Electric Co., Stillwater, Minn., who has 37 years of service in the electrical industry. Linner was recently elected vice president of the Minnesota Electrical Council, Inc.

Program of Lighting Exposition Planned

When the 2nd International Lighting Exposition and Conference convenes in Chicago's Stevens Hotel next November 3 to 7, one of the purposes served will be that of focusing world attention on importance of "Planned Lighting" for industry, business, farms, stores, schools, streets, airports.

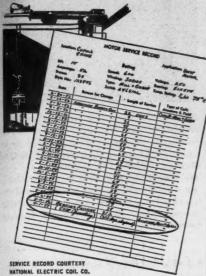
Through a series of four morning conferences, the Exposition Committee will seek to make better known the practical applications of the newest developments in illumination and the importance of the Exposition's theme, "Plan Tomorrow's Lighting Today." Tickets to the Conferences are available to architects, electrical contractors, wholesalers, industrial executives, illumination engineers, school men, business men, public officials, utility personnel, railroad officials, oil company executives, and all other industrial and commercial officials concerned with lighting. The conference program as announced is as follows: Tuesday, "Trends and Progress in Lighting"; Wednesday, "Industry Plans for Lighting Promotion"; Thursday, "How the Electrical Wholesaler Can Increase His Lighting Sales"; and Friday, "The Electrical Contractor, the Key Man in the Lighting Plan".

Each conference session will feature men who are recognized as outstanding in their subject. These conference ses-





DC Silicone Insulation **CUTS MOTOR FAILURE 90%!**



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A cupola crane motor used to unload scrap in a large steel mill was designed for intermittent service. But steel hungry America kept it working full time to meet war and postwar requirements. Insulated with the best Class 'B' materials, this motor failed 22 times in about three years, giving an average service life of only 50 days. Design limitations made it impossible to install a larger motor. Lost time, costly rewinding, and heavy maintenance expense seemed inescapable—until DC Silicone Insulation was introduced by Dow Corning. National Electric Coil Co., of Columbus, Ohio, was one of the first to realize the advantages of Silicone-alass-mica insulation. Their engineers redesigned the coils of that motor using Silicone Insulation—DC 996 Varnish with glass and mica.

Then it operated almost continuously for 312 days—six times the average life with Class 'B' insulation—before a bearing failed, causing mechanical failure of the insulation. The motor was again rewound with Silicone Insulation and was still running April 1, 1947-after 323 days!

DC Silicone Insulation will keep hard-working motors running at least 10 times as long as Class 'B' insulation. That's proved by three years of tough tests and field service. DC 996 is further described in leaflet No. K 3-7.

DOW CORNING CORPORATION

MIDLAND, MICHIGAN

New York • Chicago • Cleveland • Los Angele
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London





Timing Motor: Synchronous. Self Starting. Fully enclosed. Permanently lubricated.

Manual Control: The switch may be turned "on" or "off" manually whenever desired irrespective of the time settings. Automatic Reset: Regardless of whether the switch has been turned "on" or "off" manually, the time cycle is always resumed automatically.

Accessibility: Entire machanism may be removed by loosening one screw. Motor switch, terminal block, etc., easily replaced.

Safety: Listed by Underwriters' Laboratory Re-examination Service.

* Price shown above is f.o.b. Chicago for 115 V. 60 cycle model. Other voltage and cycle combinations available at small extra charge.

SEND COUPON TODAY

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MAIL THIS
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Prominent in labor-management as tivities in the Michigan area is E. B. Clement, president and general manager of Clement Electric Co., Grand Rapids, Mich. In addition to contracting activities, his firm does considerable switchboard and control assembly work and operates a large motor repair shop employing G.I. apprentice trainees.

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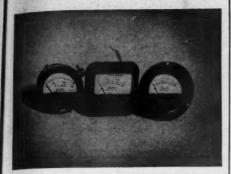
sions will afford opportunity for round table discussions and forums on practically all subjects related to the application, utilization, and sale of lighting equipment.

Winners of the Gold Seal Merit Awards in the Electrical Contractor, Electrical Wholesaling, Utility and Architects and Consulting Engineers classifications for outstanding exhibits of "Planned Lighting" installations will appear on the Monday morning, November 3d, conference session, a special forum at which the winning entries will be analyzed and discussed. Details of the Merit Award Competition for Gold Seal #100 Awards and Certificates of Merit Awards may be had from the Merit Award Committee, 326 W. Madison Street, Room 818, Chicago.

Illuminating Engineering Society—East
Central Regional Conference, Washington, D. C., May 15-16.
National Fire Protection Association—
51st annual meeting, Palmer House,
Chicago, Ill., May 26-29.
Edison Electric Institute—15th Annual
convention, Atlantic City, N. J., June
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2-5.
Pacific Coast Electrical Assn., Inc.—Mission Inn, Riverside, Calif., June 4-6.
Illinois Chapter IAEI—Seventeenth Midyear meeting, Hotel LeClaire, Moline, Ill., June 5-6.
American Society of Refrigerating Engineers—34th Spring meeting, Hotel Alexandria, Los Angeles, Calif., June 9-11.
American Institute of Electrical Engineers—Summer meeting, Montreal, Quebec, Canada, June 9-13.
New York State Association of Electrical Contractors and Dealers, Inc.—Saranac Inn, Saranac, N. Y., June 10-15.

Here's a NEW Line of AC and DC Panel Instruments



TYPES:

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Ammeters, AC and DC Milliammeters, AC and DC Voltmeters, AC and DC Resistance Meters

ACCURACY:

AC meters are double-vane, repulsion type; DC meters are polarized-vane, solenoid type. Accuracy, well within 5%.

CASE STYLES:

Three basic styles, all requiring 2-7/64" hole; round or rectangular; mounted by flange, ring or clamp. Certain DC models available with zero adjuster. Interchangeable with popular type of instrument formerly available.

FEATURES:

Rugged Construction: Metal cases, molded inner unit with coil frames and insulators integral for maximum rigidity.

Attractive Appearance: Neatly styled cases finished in dull telephone black with concealed coils and full-view scales.

All-Metal Dials: Made the same way as for much higher priced instruments, to withstand age and moisture.

Reasonably Priced: Standard models are being produced in large quantities for industrial users, making possible a complete line at moderate prices.

For ranges, specifications, and mounting dimensions, send for Bulletin F-64. Shurite Meters, 97 Hamilton Street, New Haven 8, Connecticut.

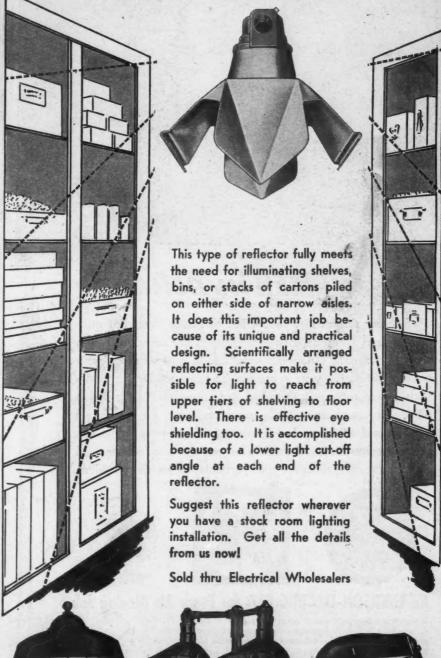


ELECTRICAL MEASURING INSTRUMENTS



AISLE-STOCK REFLECTORS

FOR IDEAL SHELVING ILLUMINATION



QUADRANGLE MFG. CO.

32 S. PEORIA ST.

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TF let-down fatigue hits your office or factory, ahead of quit-I ting time, you should do something to stir things up! Start with the stagnant, muggy air that engulfs your workers like a heavy blanket. Keep air in motion-to keep people in actionwith Emerson-Electric Fans and Air Circulators. In many an office and factory these sturdy fans actually pay for themselves in increased efficiency and improved employe-relations. Ask your Emerson-Electric Dealer to suggest the most efficient and economical equipment for your particular air-moving problem.







An EMERSON-ELECTRIC FAN for Every Air Moving Job

If yours is a business where greater comfort for customers, visitors or workers will help business, there's an Emerson-Electric Fan to do the job—direct-drive exhaust fans in five sizes from 12" to 30"—heavy-duty belt-drive exhaust fans in 48", 42", 36" and 24" sizes—dependable desk fans with 10", 12", 16" blades—air circulators (large illustration) 24" and 30" sizes with 4 styles of mountings. Write for Folder No. 310



THE EMERSON ELECTRIC MANUFACTURING CO.

St. Louis 21, Mo. ELECTRIC MOTORS · FANS

- National Electrical Manufacturers Association—Special section meetings, The Homestead, Hot Springs, Va., June 22-26.
- Illuminating Engineering Society—Annual convention, New Orleans, La., September 5-10.
- National Electrical Contractors Associa-tion—Annual meeting, Palace Hotel, San Francisco, Calif., September 8-10.
- Illuminating Engineering Society—Technical Conference, Roosevelt Hotel, New Orleans, La., September 15-19.
- International Association of Electrical Inspectors—Northwestern Section, Eugene Hotel, Eugene, Ore., Sept. 22-24; Southwestern Section, Mission Inn, Riverside, Calif., September 29-October 1; Western Section, Mount Royal Hotel, Montreal, Quebec, Canada, October 13-15; Eastern Section, Lord Baltimore Hotel, Baltimore, Md., October 20-22; Southern Section, Hotel George Washington, Jacksonville, Fla., October 27-29.
- International Municipal Signal Associa-tion, Inc.—Annual meeting, Pantlind Hotel, Grand Rapids, Mich., September 23-October 2.
- National Safety Congress & Exposition— Chicago, Ill., October 6-10.
- National Electrical Manufacturers Asso-clation—Traymore Hotel, Atlantic City, N. J., Week of Oct. 26.
- American Institute of Electrical Engineers
 —Midwest meeting, Chicago, Ill., November 3-7.
- 2nd International Lighting Exposition— Hotel Stevens, Chicago, Ill., November
- National Metal Trades Association— Palmer House, Chicago, Ill., November 6-17.
- National Association of Manufacturers— Waldorf-Astoria Hotel, New York, N. Y., December 3-5.

IANUFACTUR

G-E APPOINTMENTS

The Board of Directors of the General Electric Company has elected Edwin E. Potter to the post of vice president in charge of the commercial aspects of the company's relations with customers, succeeding vice president Earl O. Shreve, who continues as a member of the president's staff with special duties as assigned. In his new capacity, Mr. Potter will direct the activities of the company's commercial vice president in the field. His headquarters will be at 570 Lexington Avenue, New York.

William H. Milton, Jr., formerly assistant general manager of G-E's chemical department, has been elected a commercial vice president. Mr. Milton, who also has been administrator of the Hanford Engineer Works atomic-energy plant operated by G-E for the government, will have responsibility for customer relations in the District of Columbia, with headquarters in Washington.

Ray W. Turnbull was also elected a commercial vice president and in order to be available for this position has resigned as president of Hotpoint, Inc. On September 1, Mr. Turnbull,

ROYAL





IMMEDIATE DELIVERY FYRANDED PRODUCTION

EXPANDED PRODUCTION

Greatly increased production facilities enable us to meet the constantly growing demand for ADVANCE Ballasts . . . now made to meet all Fluorescent lighting needs.

60 cycle

50 cycle

118, 150, 208, 220 and 236 Volt Single and double 15, 20, 30 & 40 Watt High Power Factor & Low Power Factor

New convenient size 32 Watt CIRCLINE BALLAST. A streamlined Ballast at a streamlined price.

Write for information

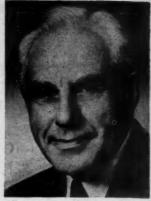
ADVANCE TRANSFORMER CO.

1124 W. Catalpa Ave., Chicago 40, III., U.S.A-Cable Address: Adtrans



Here's another example of better service with PORCELAIN protected wiring! With Porcelain Products Service Wireholders, there's a double advantage: (1) extra strength to insure long life of trouble-free service; (2) neat appearance on any building. All metal parts are rust-resistant. Designed and built to same standards of quality as high tension insulators. Dependable... utmost satisfaction all along the line—for wholesaler, contractor and consumer. Ask your Electrical Inspector about non-metallic wiring with Porcelain for safety. Write for wiring manual.





E. O. SHREVE



E. E. POTTER

with headquarters in San Francisco, will assume responsibility for customer relations in an area which includes California, Arizona, Utah, Nevada, and Hawaii, and parts of Idaho and Wyoming. In the meantime, his headquarters will be in New York.

Raymond M. Alvord, now commercial vice president in San Francisco, will relinquish his post to Mr. Turnbull September 1, and will retire at his request after 43 years' service with the company.

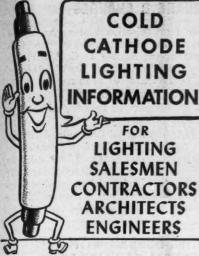
Thomas M. Linville has been named staff assistant to E. E. Johnson, manager of engineering in G-E's apparatus department at Schenectady.

WESTINGHOUSE APPOINTMENTS

A. Frye Ayers has been named central district industrial manager of the Westinghouse Electric Corporation. He succeeds J. E. Payne, who has been named manager of headquarters industrial sales.

The appointment of Will M. Kline, Jr., as assistant sales promotion manager for the Westinghouse Electric Appliance Division, Mansfield, Ohio, has been announced.

T. J. Newcomb, sales manager of the Westinghouse Electric Appliance Division, has announced the formation of the Apartment House and Builder Sales Department to replace the former Home Building Department. W. R. Arbuckle, former head of the Home Building Department, will be manager of the newly-created department.



Let this technical data and printed material help you to specify and sell Better and More Dependable lighting installations.



For commercial or industrial installations

*COLOVOLT

Cold Cathode Low Voltage Lighting offers these extra advantages

- · Longer lamp life ... one year guaranteed
- · Lower maintenance cost per foot candle of light
- · Minimum interruption of important production jobs
- · Instantaneous starting without troublesome starters
- · Engineered for individual or line lighting

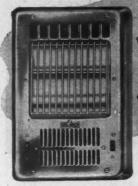
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Architectural and **Engineering Files** for 1947

*Trade Mark Registered U.S. Pat. Off. GENERAL LUMINESCENT CORP 672 S FEDERAL STREET . CHICAGO 5, ILLINOIS

BOTH are built in FAN-GLO HEETAIRE*



Check the BUILT-IN FAN-GLO

HEETAIRE yourself!

WARM COMFORT QUICKLY ... for your customers! V MORE PROFIT ... for you!

The 230 Series Built-In Wall FAN-GLO HEETAIRE is the only recessed heater built that gives you-customers—everything.

It gives your customers WARM COMFORT QUICKLY—the only recessed heater built that gives both kinds of heat—abundant infra-red plus abundant fan-forced heated air. Its infra-red rays heat all the humans in the room—quickly!

It gives you MORE PROFITS! Because it's backed by powerful selling ammunition—a dynamic convincing "Best Seller" sales manual . . . plus a veritable arsenal of new literature—catalog and specification sheets and charts . . . plus national magazine and newspaper advertising that drives home to millions of prospective customers the fact that FAN-GLO HEETAIRE is the only heater built that gives BOTH kinds of heat!

Call your jobber—he's all set to help you make more sales-more profits.

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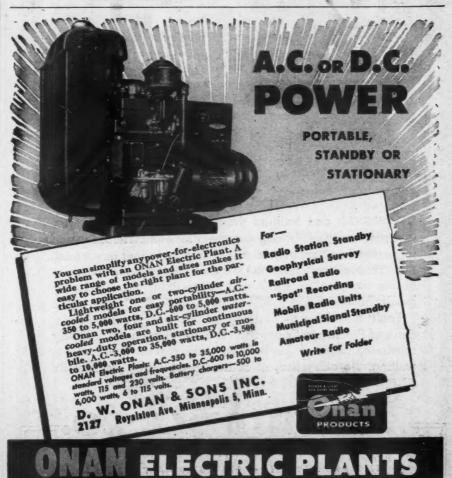
Infra-Red Rays
Patented Neo-Glo Elements
Fan-Forced Heated Air
Exclusive Two-Heat Feature—
choice of Hi-Lo Heats
Non-Rust Casing
Asbestos Lined Casing
Lifetime Service
Trouble Free
Easy to Install
Underwriters Approval
Guaranteed for One Year * Tested & Listed under Reexamination Service by UNDERWRITERS' LABORATORIES, Inc.

LA SALLE LIGHTING PRODUCTS INC.

MARKEL ELECTRIC PRODUCTS INC.

147 SENECA ST.

BUFFALO 3, N. Y.





DESIGNED and built to provide maintenance men with practically everything necessary for electrical resistance measurements from a fraction of an ohm up to 1000 megohms, the "Bridge-Meg" type of "Megger"* instrument combines in one compact, portable unit the facilities of a "Megger" Insulation Tester and a Wheatstone Bridge.

You'll find the "how and why" of the "Bridge-Meg" Insulation and Resistance Tester described fully within the profusely illustrated pages of this Bulletin of the Month. Your copy is waiting. No obligation, of course. Send today for Bulletin 21-60—ECM.

ELECTRICAL A SCIENTIFIC INSTRUMENTS
1316 ARCH STREET . PHILADELPHIA 7. PENNA.

SQUARE D CHANGES

A reorganization and expansion of advertising departments in two divisions of the Square D Company, has been announced by L. W. Mercer, G. H. LaPiner has been appointed advertising manager of the Switch and Panel Division in Detroit, with D. A. Roehm as assistant.

In the Industrial Controller Division, Milwaukee, the advertising section of the sales department will be headed by T. C. Vogel. T. B. Martin, formerly in charge of advertising, has been appointed production manager of the Industrial Controller Division.

M. M. DUNBAR WITH GENERAL DAY-LITE CO.

MacInnis M. Dunbar has joined the staff of General Day-Lite Company, Norristown, Pa., as general sales manager and director of lighting fixture design and advertising. Mr. Dunbar



M. M. DUNBAR

was formerly executive vice president and member of the board of directors of Lighting Products, Inc.

Mr. Dunbar has retained a sustaining membership in the Illuminating Engineering Society, is affiliated with NEMA, the Nebraska-Iowa Electric Association, and is a registered professional engineer in the State of Illinois. He is also a member of the Artists' Guild, Inc., and the Electric Association of Chicago, Ill.

WIREMOLD CO. ELECTIONS

At a recent meeting of the stock-holders of The Wiremold Company, Hartford, Conn., John D. Murphy and Robert H. Murphy were elected to the board of directors.

John D. Murphy, vice president and general manager, is a graduate of Dartmouth College, where he majored in economics. He has been with The Wiremold Company since 1934, working in every factory and office department. He was elected vice president in 1942.

Robert H. Murphy, assistant treasurer and factory manager, graduated from Dartmouth College in 1936 where

"JIFFY" ADJUSTABLE CUTTER

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CUTS HOLES FAST

"JIFFY" CUTTER makes quick easy work of cutting operation. Cuts holes from 34" to 5" in diameter through any gauge sheet metal, cast iron or steel up to 34" thick. Will also cut slate, marble, bakelite and other fiber materials. A timesaver on switchbox jobs that usually require extra holes where there are no knock-outs. Compact, light weight. Useful in switchboard building, industrial plants, sheet metal shops. Ratchet wrench and spring pressure permits easy operation in corners, chickling or in any cramped position.

The Jiffy Line

SOLD BY YOUR JOBBER Write for "Jiffy" folder EC for full details.

CLYDE W. LINT 300, 1144 W. Washington Blvd. Room CHICAGO 7, ILLINOIS



your plant and to recommend the proper brushes to be used in each case and compile all technical data into book form for your references. It will be your guide to efficient operation and increased production.

THE OHIO CARBON COMPANY 12508 BEREA ROAD CLEVELAND II OHIO

MERCOID CONTRO



MERCOID RELAYS

MERCOID HAS WHAT EXPERIENCED ENGINEERS WANT IN AN AUTOMATIC CONTROL

- 1. Designed for positive safety—the prime purpose of a control.
- 2. Built for years of dependable performance-a very desirable
- 3. Simplified for ease of installation-appreciated by the trade.
- 4. Convenient facilities for making understandable adjustments-no time lost in calculating or guesswork.
- 5. The only 100% Mercury Switch Equipped Control Linewhich means that all "makes" "and breaks" in the electrical circuit are hermetically sealed, therefore immune to dust, dirt, corrosion, open arcing, pitting, or sticking of contacts-all common causes of contact trouble. Mercoid Switches provide an electrical contact that will give millions of perfect operations.

The above facts merit your consideration. For detailed information see Mercoid catalog No. 600.



EXPLOSION PROOF





THE MERCOID CORPORATION + 4901 BELMONT AVENUE + CHICAGO, ILLINOIS

DON'T SOLDER



MOTOR CHARTING SERVICE

Our engineering department is capably staffed to make a survey of all motors and generators in

IT'S ABSOLUTELY FREE OF CHARGE!

WRITE TODAY FOR DATA SHEET No. U-5 It contains complete specifications on SCRU-IT sizes, dimen-sions, uses, etc.

Fast, Efficient, Economical WIRE CONNECTORS

"Roughing in" of permanent wiring is simplified with SCRU-ITS. They form efficient and safe connections without using tape, solder or tools. Better mechanical contact—no shorts or grounding. Compact in size

EASY TO USE .

- 1. STRIP WIRE ENDS
- 2. SCREW IT
- 3. THAT'S IT-WITH SCRU-ITS!

Four sizes for joining many combinations of AWG solid and/or stranded wires.

101 USES . . . Here Are a Few!

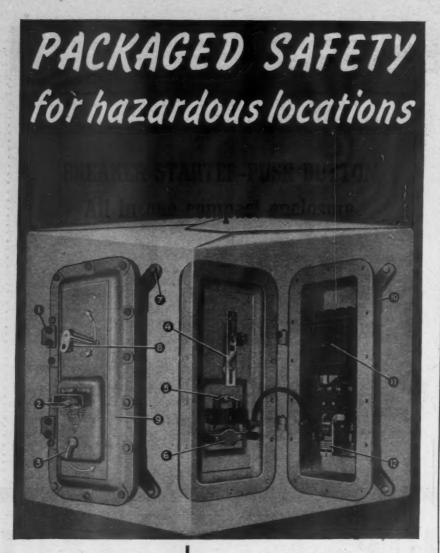
- Fixtures Outlet Boxes Fuse Boxes

- Lighting Devices
 Conduit Boxes
 Circuit Breakers
 Switch Controls
 Motor Connection

ELECTRIC CORPORATION

FACTORY and SALES OFFICES

WARREN, PENNSYLVANIA



- 1 Hinges of Bronze . . Unbreakable
- 2 Start-stop . . . Guarded No accidental Starting
- 3 Overload Manual Reset *
- Slide Mechanism . . . 4 Minimum wear on Breaker Handle
- 5 Push Button Lever . . . Rocker type
- 6 Overload Reset . . . Cam & Lever Action
- 7 Mounting Lugs . . . Extra Rugged
- Can be padlocked in both ON or OFF positions . . . Breaker TRIP FREE
- 9 Corrosion Resisting
- 10 Close grain High Tensile Gray iron casting
- Combination Thermal and Magnetic Breaker , .Max. 100 Amp.
- 12 A.C. Magnetic Starter
 Line Voltage Type

Designed to meet all Underwriters' Requirements For Class I Group D installations.

ALL ACTUATING SHAFTS ROTATE THROUGH OILITE BEARINGS . . . WILL NOT FREEZE

OTHER COMBINATIONS AND Ratings can be furnished

Installation costs at a minimum

Over Four Decades of Experience Designing Electrical Specialties

Representatives in all Principal Cities



J. D. MURPHY



R. H. MURPH

he specialized in chemistry and mathematics. He has worked at the company since 1936, starting as clerk in the factory office, then as a machine operator and then draftsman. He was elected assistant treasurer and factory manager in 1942.

FEDERAL APPOINTS THREE DISTRICT SALES MANAGERS

Three new district sales managers have been appointed by Federal Electric Products Company, Newark, N. J. William M. Stark becomes manager

William M. Stark becomes manager of the company's southwestern district, with headquarters in St. Louis; George L. Stout is the new manager of the east central district with offices in Cincinnati; and Clarence G. Landeck becomes manager of the middle western district with headquarters in Chicago.

ALLIS CHALMERS APPOINTMENT

Arthur D. Brown, formerly manager of the Los Angeles Allis-Chalmers district office, has been named manager of the company's Washington, D. C. office. R. N. Landreth, who has been acting manager of the Washington office, will now devote full time to his special duties as assistant to W. C. Johnson, vice president of the general machinery division.

A. D. Robertson, formerly assistant manager of sales and engineering of



RUSSELL & STOLL COMPANY, INC.

Precision-Built Electrical Equipment 125 BARCLAY STREET, NEW YORK 7, N. Y



ILSCO LUGS AND CONNECTORS

Economy

FOR EXAMPLE: ONLY SIX SIZES FOR 16 WIRES

No. 14 to 1,000,000 c.m. inclusive.

Every connector can be used over and over again. Minimum wiring time . . . lower wiring costs.

Write for 48-page illustrated catalog.



ILSCO COPPER TUBE
APRODUCTS, Inc.

Faster, Accurate DRILLING in MASONRY with the CYCLONE Carbide Tipped ROTARY BIT

The New, Easy Way with the new CYCLONE Masonry DRILL, fastest, most accurate drill ever made. For concrete, brick, tile, slate. Do your job 4 to 8 times Come in-dividually packaged or in handy faster, without effort, with the drill that stays sharp longer and outkit of six lasts ordinary steel bits 50 to 1. Fits hand brace, electric drill or drill press.

NEW ENGLAND CARBIDE TOOL CO. INC.

CAMBRIDGE 39, MASS.



For Quick Installation and Positive Grip



ADALET CABLE SUPPORTS

This wedge bushing is a strong, compact thoroughly insulated device for supporting cables in conduit risers. Meets every Code requirement.

The insulating wedges are tailored to accurately fit both the cables and the retaining bushing. They are quickly inserted after the cables are pulled, and driven into place with a hammer. (In the illustration, one of the wedges has been removed to show the construction). The heavier the pull, the tighter they grip the cables. Made for 1 to 6 cables. Conduit size: 1" to 6".

If you are not already using Adalet Wedge Bushings, write for full information.



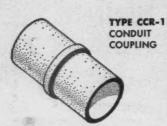
MANUFACTURING CO.

1448 EAST 49th ST.

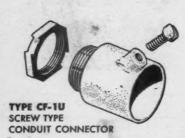
CANNON ELECTRIC

Conduit Fittings

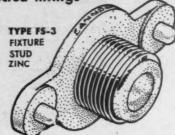
Improved delivery schedules
Fully inspected fittings



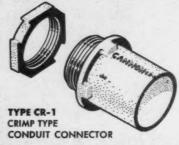
Thin wall 14" E.M.T. indenter tool type, Zinc. Standard package 500 pieces; carton 100 pieces. Approx. 1800 pieces per 100 lbs.



Listed as approved by Underwriters' Lab. Two sizes: ½" and ¾". Single set screw type. Aluminum or zinc material. ½-14 Am. Nat. Standard Pipe Thread. Packaged in lots of 500; carton 100; approx. 1800 pieces per 100 lbs.



FS-3 No Bolt Fixture Stud has %" pipe thread, but no internal thread. Now available with lock nuts. Tested as follows: (1) Vertical breaking point 600 lbs, (2) 27° angle test with 20" pipe (3) Torque from 300 to 337 inch-pounds.



For ½" E.M.T, thin wall condult, indenter tool type, Material, zinc, Same thread and locknut as CF-IU. Standard package 500 pieces; carton 100 pieces; approx, 1500 pieces per 100 lbs.

PARTS CNT-1)

TYPE CNT-1
REVERSIBLE CLAMP TYPE BOX CONNECTOR

(EXPLODED VIEW

For BX—Romex armored cable, non-metallic sheathed cable, CNX concentric covered neutral house wire, and rubber-jacketed portable cords having an outside diameter of from 5/32" to 21/32". Reversible clamp for smaller sizes. Standard package 1000; carton 100. Approx. 2000 pieces per 100 lbs.

For details and prices on the Conduit Fitting line, write for Bulletins CF-2 and FS-3. Address Dept. E-231. Bulletins on the various lines of multi-contact electric connectors and hospital signal equipment also available upon request.



3209 Humboldt Street, Los Angeles 31, California Canada & British Empire — Cannon Electric Co., Ltd., Toronta, Ontario • World Export Agents (excepting British Empire) Frazar & Hansen, 301 Clay St., San Francisco 11, Calif. the electrical section at the Norwood Works, has been named manager of the company's Tampa, Fla., district office, succeeding the late Berrien Moore,

E. R. McCARTHY NAMED SALES MANAGER OF SORENSEN

Edward R. McCarthy has been appointed general sales manager of Sorenson & Company, Inc. Before joining Sorenson, Mr. McCarthy was affiliated with Pneumatic Products, Inc. in a sales and engineering capacity. He has also been with General Motors as a liaison engineer and with Sikorsky as a production loftsman.



E. R. McCARTHY

Mr. McCarthy, who will have overall responsibility for the merchandising and sales of Sorenson's standard line, was graduated from Carnegie Tech.

GRAYBAR APPOINTMENTS

C. H. McClean has been elected a director of Graybar Electric Company. He has had 34 years of service, starting at Kansas City in the telephone shop. Since 1946 he has been Graybar's district manager at Minneapolis.

John W. Van Dorsten has been appointed manager of the Winston-Salem, N. C. office and warehouse. He succeeds W. A. Morrefield, who was transferred to Richmond as assistant to the Southwestern Distict manager.

WESCO APPOINTMENTS

H. A. Steinmeyer has been named midwest district apparatus and supplies manager of the Westinghouse Electric Supply Company, with head-quarters in St. Louis, to succeed J. N. Crevasse, resigned.

E. J. Davis, former sales representative of the northern district, has been appointed lighting specialist with headquarters in Milwaukee. He will work



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YES, THAT'S TRUE! No more ringing-out when you use E-Z Code Wire Markers. Wrap each end of the wire with an E-Z Code - pull through conduit - that's all! Each wire is clearly identified as E-Z Codes will go through conduit.

We stock over 325 codes (including ASA & NEMA standards) to code most electrical installations. Special codes can readily be made for special requirements.



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FREE SAMPLES

WESTERN LITHOGRAPH COMPANY Dept. M 21. 600 E. Second St. Los Angeles 54, California





CHECK THE Automatic LINE

For any load . . . for every installation, there is an Automatic Time Switch to meet the most rigid specification. Compact, ruggedly constructed Automatic Switches have pure silver contacts... tamper proof cabinets with visible dial... 2 to 24 "on" and "off" operations. For dependable automatic time witches specify Automatic.

Specifications and Information

Time Switches Interval Timers Poultry Switches Progressive jobbers have complete information on Automatic products. Catalog mailed direct at your request.

WRITE TODAY!

Automatic Electric MFG. CO.

50 STATE ST., MANKATO, MINNESOTA

FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCK **AUTHORIZED PARTS DISTRIBUTOR**

Brown-Brockmeyer Century Cutler-Hammer Delco

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Master Peerless **Robbins & Myers** Star Thor Wagner Westinghouse

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

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New York 8, N. Y.



When it comes to buying electric cords and cables he knows that wise purchasing is earning power too, for by demanding TIREX he saves many important dollars that would otherwise be spent for repairs and eventual replacements.

Simplex-TIREX Cords and Cables are the products of skilled engineering and are designed to give dependable service even under the most adverse operating conditions.

Finely stranded conductors provide the flexibility required wherever portable cables are used, and they are insulated with a compound having adequate electrical properties and lasting mechanical strength.

The outer jacket of Selenium Neoprene Armor, reinforced by a hard-twisted seine twine braid, assures resistance to sunlight, oil, flame and abrasives to a degree unsurpassed by any other cable.

Add up the features TIREX offers and you'll find they add up to long-run savings for you. That's why the economy-wise specify Simplex-TIREX Cords and Cables when ordering.



SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

in the Madison, Green Bay and Milwaukee branch areas.

E. M. Lacey has been appointed manager of the Newark, N. J. branch, succeeding Eric Hall, who has been appointed district manager of the Central New York State district with head-quarters at Rochester, N. Y.

Taking over Mr. Lacey's post as district appliance manager is R. A. Gopel, formerly branch appliance manager at Newark

R. H. Colborn has been named branch manager at Trenton, N. J., succeeding E. C. Rutter.

Two new sales representatives have been appointed by the Bright Light Reflector Co., Inc., Bridgeport, Conn. Harry A. Miller, Dallas, Texas, will cover the states of Arkansas, Oklahoma and Texas. Donald S. Gleason, Seattle, Wash., has been assigned a territory embracing Idaho, Oregon and Washington.

John A. Roebling's Sons Company, Trenton, N. J., announces the appointment of A. R. Robinson as manager of the company's Seattle Branch. J. F. Berger has been named assist-

J. F. Berger has been named assistant sales manager of the Woven Wire Fabrics Division of John A. Roebling's Sons Company.

George J. Read has been appointed general manager of Chelsea Products, Inc., Irvington, N. J. He will be active in the sales promotion, advertising and management aspects of the business.

Eastern Amplifier Corporation, New York, announces that S. K. Lackoff has joined its organization as chief engineer and Gerson Lewis as executive assistant to Leon Alpert, who is vice president and general manager.

Wheelco Instruments Company, Chicago, announces the election of Elmer Schneider to a newly created position, vice president and director of engineering.

Joseph A. Reinhardt will become plant manager and assume responsibility for all manufacturing operations.

The Chicago territory of Swivelier Company, Inc., of New York City, is now being covered by the George Butler Co., located at 1015 West Washington Blvd.

The Simplet Electric Company has moved into its new plant at 3600 W. Potomac Ave., Chicago.

I . D . E . A

POWER

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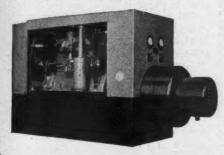
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ELECTRICITY When and Where You Need It

The thorough dependability and economy of I•D•E•A units result from advanced engineering and the combination of world-famous International Harvester Engines and the finest electric generators made. I•D•E•A units range from 3 KW to 50 KW (either AC or DC). All possess PLUS advantages users can see immediately. A choice of gasoline or diesel driven models to suit every requirement.

DEALERS: I • D • E • A Power represents today's BIG opportunity for steady sales and profits. Write for details.



INTERNATIONAL DIESEL ELECTRIC CO., INC.
LONG ISLAND CITY, N.Y.

SEPARABLE SOCKET TYPE PORCEIAIN ON STEEL

PORCELAIN ON STEEL "ABolite" REFLECTORS

Quality that meets every lighting requirement has always been the watchword of "ABolite" Reflectors. They are recognized throughout the lighting field for flawless construction, durability, ease of installation and maintenance.

A few of the standard types are shown. The complete "ABolite" line includes other types for outdoor use, protective lighting, sports and parking areas, filling stations and sign lighting. For every application where high efficiency with porcelain on steel enameled reflectors and floodlights is required.

Abolite Reflectors are sold exclusively through electrical wholesalers. Catalog for specifications sent on request.

Light right with . . .



EASY DETACHABLE TYPE ELLIPTICAL ANGLE

THREADED NECK TYPE GLASS-STEEL DIFFUSER

FORMED NECK TYPE

THE JONES METAL PRODUCTS CO., West Lafayette, Ohio

ALBANY RBR

the lubricant for PULLING every type of covered WIRE

Whether you are pulling rubber, braided or synthetic wire—it's EASIER and FASTER with ALBANY RBR. This lubricant won't dissolve or soften coating, will not separate or evaporate. It's easier to apply—shows lower stress. And permits easy removal of wire when necessary. See how much time and money you can save on your next wire-pulling job with Albany RBR!



Order from your Supply House or Direct. 10 lb. CAN (6 to carton) 25 lb. PAIL—1/4 DRUM (about 125 lbs.)—DRUM (about 500 lbs.)

ELECTRICAL PRODUCTS DIVISION

ADAM COOKS SONS.

Mirs of Albany Lubricating Products

LINDEN, NEW JERSEY

RELIANCE TIME SWITCHES



Model "W"

Completely automatic
... extremely simple,
compact, economical
... three types cover
practically every requirement ...

ASTRONOMIC TIME SWITCH

• The Model "W" Astronomic types are particularly popular for advertising illumination. The "on" operation changes daily to correspond with local sunset time, eliminating the necessity of resetting the dial as the days become longer or shorter.

AMERICA'S RELIABLE 24 hour-a-day GUARDIANS

RELIANCE Time Switches have proved their dependability. They give complete and reliable service under many varied conditions—a factor of paramount importance when constant good service is essential. Send for catalog and price sheets for complete details.

RELIANCE AUTOMATIC LIGHTING CO.
1907 MEAD STREET RACINE, WISCONSIN



MORE QUALITY FOR LESS MEANS BIG NEW VOLUME FOR YOU!

Now you can make more Window Ventilator sales than ever before! Berns' amazingly low prices mean that more people than ever can afford the added comfort of window ventilators. Berns-built engineering assures longer-lasting, more satisfying operation. It's the window ventilator promotion every department, appliance, hardware store and other fan outlet has been waiting for! They're priced to fit every purse...styled for the most discriminating taste...built for the most quality conscious buyer! Place your order today!

SOLD EXCLUSIVELY THROUGH LEADING ELECTRICAL WHOLESALERS

ATERING BERNS MFG. CORP.

Formerly Berns Specialty Mfg. Co. 2278 ELSTON AVE., CHICAGO 14, ILL.

The Electric Products Company, Cleveland, Ohio, announces the appointment of Robert H. Ehret to the position of assistant sales manager.

Roller-Smith, Bethlehem, Pa., announces the appointment of Edward S. Maury as manager of instrument sales. He was formerly research engineer for the Signal Corps Engineering Laboratories. Mr. Maury will make his headquarters at Bethlehem.

Marion Electrical Instrument Company, Manchester, N. H., announces that the jobber division of the company is now located in Manchester, N. Y.

Edward A. Damrau, formerly in charge of the Pittsburgh, Pa., office of The Okonite Company, has been appointed manager of the company's new branch office at 601 Chamber of Commerce Building, Charleston, W. Va.

Allied Control Company, Inc., New York, has sold its Chicago plant to the General Transformer Co. and the equipment and personal property to S. L. Winternitz & Co. All Allied relays will now be manufactured at its plant at Plantsville, Conn. All sales will be handled from its general sales offices in New York City.

The Standard Transformer Company, Warren, Ohio, announces the appointment of R. Thorp & Associates to represent them in the state of Kansas and the western part of Missouri. The Thorp concern is located in the 20 West 9th Street Building, Kansas City, Mo.

W. F. Jessup, until recently chief of the Wire Mill Branch, Copper Division, CPA, has joined the Cornish Wire Company, 15 Park Row, New York City, as sales manager of that organization's Cord Division.

Ralph L. Corey has been appointed vice president of Great American Industries, Inc., New York. Mr. Corey will be general manager of the corporation's Connecticut Telephone & Electric Division, Meriden, Conn., where he will make his headquarters.

The appointment of B. E. McNeil as Houston representative, has been announced by the Helwig Co., Milwaukee. Mr. McNeil is located at 1101 Chenevert St., Houston.